ISBN: 978-1-4799-5302-8

IEEE
Advancing Technology for Humanity

Proceedings of

2014 6th International Conference on Information Technology and Electrical Engineering

ICITEE 2014

2014 6th International Conference on Information Technology and Electrical Engineering

"Leveraging Research and Technology through University-Industry Collaboration"

Eastparc Hotel, Yogyakarta
7-8 October 2014

Organized by
Department of Electrical Engineering and Information Technology
Faculty of Engineering, Universitas Gadjah Mada
Jalan Grafika 2 Yogyakarta 55281, Indonesia

ICITEE 2014 Partners and Sponsors

Organized by

Co-organized by

Technically Co-Sponsored by

Supported by

Welcome Message from the General Chair

On behalf of the organizing committee, it is our pleasure to welcome you to Yogyakarta, Indonesia, for our annual conference. This is the 6th conference that is held by the Department of Electrical Engineering and Information Technology, Faculty of Engineering, Universitas Gadjah Mada. This year, the conference is differently called as Joint conference 2014 as there will be 4 parallel conferences, including:

1. ICITEE (International Conference of Information Technology and Electrical Engineering) 2014,
2. CITEE (Conference of Information Technology and Electrical Engineering) 2014,
3. RC-CIE (Regional Conference on Computer and Information Engineering) 2014, and
4. CCIO (Conference on Chief Information Officer) 2014.

The joint conference's theme is "Leveraging Research and Technology through University-Industry-Government Collaboration" emphasizes on the enhancement of research in a wide spectrum, including information technology, communication and electrical engineering, as well as e-services, e-government and information system. The conference is expected to provide excellent opportunity to meet experts, exchange information, and strengthen the collaboration among researchers, engineers, and scholars from academia, government, and industry.

In addition, the conference committee has invited five renowned keynote speakers, Prof. Marco Aiello from University of Groningen (RuG), Netherland, Prof. Einoshin Suzuki from Kyushu University, Prof. Yoshio Yamamoto from Tokai University, Prof. Jun Miura from Toyohashi University of Technology, and Prof. Kazuhiko Hamamoto from Tokai University, Japan. The conference committee also invited Tony Seno Hartono from National Technology Officer of Microsoft Indonesia and Dr. Ing. Hutomo Suryo Wasisto (Associate Team Leader in MEMS/NEMS and Sensor Group) Technische Universität Braunschweig, Germany as Invited speaker to present their current research activities.

This conference is technically co-sponsored by IEEE Indonesia Section. Furthermore, it is supported by JICA, AUN/SEED-Net, Ministry of Communication and Information Technology of The Republic of Indonesia, and King Mongkut's Institute of Technology Ladkrabang, Thailand.

As a General Chair, I would like to take this opportunity to express my deep appreciation to the organizing committee members for their hard work and contribution throughout this conference. I would also like to thank authors, reviewers, all speakers, and session chairs for their support to Joint Conference 2014.

In addition to the outstanding scientific program, we hope that you will find time to explore Yogyakarta and the surrounding areas. Yogyakarta is city with numerous cultural heritages, natural beauty, and the taste of traditional Javanese cuisines, coupled with the friendliness of its people.

Lastly, I would like to welcome you to Joint Conference 2014 and wish you all an enjoyable stay in Yogyakarta.

Sincerely,

Hanung Adi Nugroho, Ph.D.
General Chair of Joint Conference 2014

Welcome Message from the TPC Chair

On behalf of the technical program committee (TPC), we warmly welcome you to the 6th International Conference on Information Technology and Electrical Engineering (ICITEE 2014) in the cultural city of Yogyakarta, Indonesia. The committee has organized exciting technical programs for ICITEE 2014 with conference theme of "Leveraging Research and Technology through University-Industry Collaboration." As an annual International conference, ICITEE provides excellent platform to share innovative idea and experiences, exchange information, and explore collaboration among researchers, engineers, practitioners and scholars the field of information technology, communications, and electrical engineering.

All 163 submitted papers from 18 countries throughout the world went through a rigorous review process and each paper was evaluated by at least three independent reviewers in accordance with standard blind review process. Based on the results of the rigorous review process, 78 papers have been selected, which constitute the acceptance rate of 47.9%. These papers have been grouped into 5, ranging from the fields of information technology, communications, power systems, electronics, and control systems. Besides those regular sessions, ICITEE 2014 also features world-class keynote/plenary speeches and distinghuish-invited speakers that reflect the current research and development trends in the aforementioned fields.

We are deeply indebted to all of our TPC members as well as our reviewers, who volunteered a considerable amount of their time and expertise to ensure a fair, rigorous, and timely review process. Many thanks should be given to our keynote and invited speakers who will share their experience in this conference. Last but not least, our sincere gratitude should be given to all authors for submitting their work to ICITEE 2014, which has allowed us to assemble a high quality technical program.

Welcome to Yogyakarta and hope you will enjoy a wonderful experience in this traditional city of Indonesia.

With best regards,

TPC Chair

Committees

Advisory Board Committee

Adhi Susanto (Universitas Gadjah Mada, Indonesia)
Dadang Gunawan (Universitas Indonesia, Indonesia)
Yanuarsyah Haroen (Institut Teknologi Bandung, Indonesia)
Kuncoro Wastuwibowo (IEEE Indonesia Section)
T. Haryono (Universitas Gadjah Mada, Indonesia)
Chanboon Sathitwiriyawong (KMITL, Thailand)
Hidekazu Murata (Kyoto University, Japan)
Ruttikorn Varakulsiripunth (Thai-Nichi Institute of Technology, Thailand)
Lukito Edi Nugroho (Universitas Gadjah Mada, Indonesia)
Son Kuswadi (PENS, Indonesia)

Organizing Committee

Sarjiya (Universitas Gadjah Mada, Indonesia)
Eka Firmansyah (Universitas Gadjah Mada, Indonesia)
Hanung Adi Nugroho (Universitas Gadjah Mada, Indonesia)
I Wayan Mustika (Universitas Gadjah Mada, Indonesia)
Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia)
Sigit Basuki Wibowo (Universitas Gadjah Mada, Indonesia)
Kuntpong Woraratpanya (KMITL, Thailand)
Prapto Nugroho (Universitas Gadjah Mada, Indonesia)
Teguh Bharata Adji (Universitas Gadjah Mada, Indonesia)
Sumet Prabhavat (KMITL, Thailand)
Natapon Pantuwong (KMITL, Thailand)
Noor Akhmad Setiawan (Universitas Gadjah Mada, Indonesia)
Indriana Hidayah (Universitas Gadjah Mada, Indonesia)
Kitsuchart Pasupa (KMITL, Thailand)
Avrin Nur Widiastuti (Universitas Gadjah Mada, Indonesia)
Teerapong Leelanupab (KMITL, Thailand)
Iswandi (Universitas Gadjah Mada, Indonesia)
Budi Setiyanto (Universitas Gadjah Mada, Indonesia)
Bimo Sunarfri Hantono (Universitas Gadjah Mada, Indonesia)
Yusuf Susilo Wijoyo (Universitas Gadjah Mada, Indonesia)
Agus Bejo (Universitas Gadjah Mada, Indonesia)
Husni Rois Ali (Universitas Gadjah Mada, Indonesia)
Azkario Rizky Pratama (Universitas Gadjah Mada, Indonesia)
Lilik Suyanti (Universitas Gadjah Mada, Indonesia)
Nawang Siwi (Universitas Gadjah Mada, Indonesia)

Technical Program Committee

Addy Wahyudie (United Arab Emirates University, UEA)
Adha Imam Cahyadi (Universitas Gadjah Mada, Indonesia)
Adhi Susanto (Universitas Gadjah Mada, Indonesia)
Alagan Anpalagan (Ryerson University, Canada)
Amirthalingam Ramanan (University of Jaffna, Sri Lanka)
Andy Warner (Google)
Anto Satriyo Nugroho (BPPT, Indonesia)
Anton Satria Prabuwono (Universiti Kebangsaan Malaysia, Malaysia)
Ardyono Priyadi (Institute of Technology Sepuluh Nopember, Indonesia)
Armein Z. R. Langi (Bandung Institute of Technology, Indonesia)
Awinash Anand (Kyushu University, Japan)
Azwirman Gusrialdi (University of Central Florida, USA)
Boonprasert Suravkratanasakul (KMITL, Thailand)
Chalermsub Sangkavichitr (KMUTT, Thailand)
Chanboon Sathitwiriyawong (KMITL, Thailand)
Chotipat Pornavalai (KMITL, Thailand)
Cuk Supriyadi Ali Nandar (BPPT, Indonesia)
Dhany Arifianto (Institute of Technology Sepuluh Nopember, Indonesia)
Dhomas Hatta Fudholi (La Trobe University, Australia)
Eiji Okamoto (Nagoya Institute of Technology, Japan)
Ekachai Leelarasmee (Chulalongkorn University, Thailand)
Esa Prakasa (LIPI, Indonesia)
F Danang Wijaya (Universitas Gadjah Mada, Indonesia)
Fahkriy Hario P (Universitas Brawijaya, Indonesia)
Fikri Waskito (Nanyang Technological University, Singapore)
Gamantyo Hendrantoro (Institute of Technology Sepuluh Nopember, Indonesia)
Gunawan Wibisono (Indonesia University, Indonesia)
Gusti Agung Ayu Putri (Udayana University, Indonesia)
Harris Simaremare (Universite de Haute Alsace, France)
Haiguang Wang (Institute for Infocomm Research, Singapore)
Haruichi Kanaya (Kyushu University, Japan)
Heroe Wijanto (Institut Teknologi Telkom, Indonesia)
Hutomo Suryo Wasisto (Technische Universität Braunschweig, Germany)
I Ketut Gede Dharma Putra (Udayana University, Indonesia)
I Made Yulistya Negara (Institute of Technology Sepuluh Nopember, Indonesia)
I Nyoman Satya Kumara (Udayana University, Indonesia)
I Putu Agung Bayupati (Udayana University, Indonesia)
Ida Ayu Dwi Giriantari (Udayana University, Indonesia)
Igi Ardiyanto (Toyohashi University of Technology, Japan)
Issarachai Ngamroo (KMITL, Thailand)
Ivanna Timotius (Satya Wacana Christian University, Indonesia)

Iwan Setiawan (Satya Wacana Christian University, Indonesia)
Jaziar Radianti (University of Agder, Norway)
Joko Siswantoro (Universitas Surabaya, Indonesia)
Kang-Hyun Jo (Ulsan University, Korea)
Kazunori Hayashi (Kyoto University, Japan)
Kazuto Yano (ATR, Japan)
Khoirul Anwar (Japan Advanced Institute of Science and Technology, Japan)
Kitsuchart Pasupa (KMITL, Thailand)
Koji Yamamoto (Kyoto University, Japan)
Kuntpong Woraratpanya (KMITL, Thailand)
Lesnanto Multa Putranto (Hokkaido University, Japan)
Maleerat Sodanil (KMUNB, Thailand)
Mamiko Inamori (Tokai University, Japan)
Manop Phankokkruad (KMITL, Thailand)
Marco Aiello (University of Groningen, Netherland)
Maulahikmah Galinium (Swiss German University, Indonesia)
Mauridhi Hery Purnomo (Institute of Technology Sepuluh Nopember, Indonesia)
Mustansar Ghazanfar (University of Southampton, UK)
Natapon Pantuwong (KMITL, Thailand)
Nawat Kamnoonwatana (Mahidol University, Thailand)
Nidapan Sureerattanan (Thai-Nichi Institute of Technology, Thailand)
Nihan Tran (University of Melbourne, Australia)
Nol Premasathian (KMITL, Thailand)
Noopadol Maneerat (KMITL, Thailand)
Nopporn Chotikakamthorn (KMITL, Thailand)
Olarn Wongwirat (KMITL, Thailand)
Pattaracha Lalitrojwong (KMITL, Thailand)
Pichai Aree (Thamassat University, Thailand)
Poramote Wardkein (KMITL, Thailand)
Pornvalai Chotipat (KMITL, Thailand)
Ramesh Pokharel (Kyushu University, Japan)
Rohana Sapawi (University Malaysia Sarawak, Malaysia)
Rony Seto (Institute of Technology Sepuluh Nopember, Indonesia)
Rukmi Sari Hartati (Udayana University, Indonesia)
Ruttikorn Varakulsiripunth (Thai-Nichi Institute of Technology, Thailand)
Sakchai Thipchaksurat (KMITL, Thailand)
Saiyan Saiyod (Khon Kaen University, Thailand)
Selo Sulistyo (Universitas Gadjah Mada, Indonesia)
Singha Chaveesuk (KMITL, Thailand)
Sisdarmanto Adinandra (Universitas Islam Indonesia, Indonesia)
Somjet Suppharangsan (Burapha University, Thailand)
Sompong Valuvanathorn (Ubon Ratchathani University, Thailand)
Sooksan Panichpapiboon (KMITL, Thailand)
Soradech Krootjohn (KMUNB, Thailand)
Sorawat Chivapreecha (KMITL, Thailand)
Sumet Prabhavat (KMITL, Thailand)
Sunisa Rimcharoen (Bhurapa University, Thailand)
Sunu Wibirama (Tokai University, Japan)
Supakit Nootyaskool (KMITL, Thailand)
Supawan Amanab (KMITL, Thailand)
Supot Nitsuwat (KMUNTB, Thailand)
Surachai Chaitusaney (Chulalongkorn University, Thailand)
Surapan Airphaiboon (KMITL, Thailand)
Surin Kittitornkun (KMITL, Thailand)
Suvapadee Aramvith (Chulalongkorn University)
Teerapong Leelanupab (KMITL, Thailand)
Thanisa Numnonda (KMITL, Thailand)
Thippaya Chintakovid (KMUNB, Thailand)
Udayanto Dwi Atmojo (The University of Auckland, New Zealand)
Uke Kurniawan Usman (ITTelkom, Indonesia)
Umar Khayam (Bandung Institute of Technology, Indonesia, Indonesia)
Virach Sornlertlamvanich (NECTEC, Thailand)
Wanchalem Pora (Chulalongkorn University)
Wawta Techataweewan (Srinakharinwirot University, Thailand)
Wayan Gede Ariastina (Udayana University, Indonesia)
Wimol San-Um (Thai-Nichi Institute of Technology, Thailand)
Widyawan (Universitas Gadjah Mada, Indonesia)
Yasushi Kato (Tsuruoka National College and Technology, Japan)
Yi Ren (National Chiao Tung University, Taiwan)
Yoshikazu Washizawa (The University of Electro-Communications, Japan)
Yoshimitsu Kuroki (Kurume National College of Technology, Japan)

Table of Contents

Technical Sessions

➢ Session 1. Software Engineering, Services, and Information Technology

➢ Session 2. Wireless Communications, Networking and Vehicular Technology

➢ Session 3. Power Systems

➢ Session 4. Electronics, Circuits, and Systems

➢ Session 5. Control Systems

Session 1

Software Engineering, Services and Information Technology

A Real Time Mission-Critical Business Intelligence for Development of Mixture Composition on Aromatherapy Product Based on Customer Personality Type

Taufik Djatna
Post Graduate Program of Agro-industrial Technology
Bogor Agricultural University
Bogor, Indonesia
taufikdjatna@ipb.ac.id

Ida Bagus Dharma Yoga Santosa
Post Graduate Program of Agro-industrial Technology
Bogor Agricultural University
Bogor, Indonesia
yogasantosa@apps.ipb.ac.id

***Abstract*—Aromatherapy products, like spa mixture, scrub, soap, perfume, and others are individual and very subjective preferences which have high value of business. They require for rapid responses while fulfilling customer needs and mix ordered active note to serve customer preferences. Such requirement needs a real time mission-critical business intelligence which ensures effectiveness and efficiency on fulfilling customer need. In this paper, the objectives are to acquire and to formulate customer preference requirement on aromatherapy product in real time mode. Main characteristics are on key performance indicators (KPI) and displayed them for evaluation in form of dashboard. The formulation worked with sort of databases which filled by customer interaction in real time mode to determine best aromatherapy personal mixture by using quantification theory type 1 (QTT-1) method. QTT-1 is an effective analysis method for building a mathematical model of the relationships between customer personality type and aromatherapy mixture compositions. Dashboard generated from KPI ease the decision making on each element in business intelligence. Further personality approaches are needed to cover each specific requirement on different group of customers.**

Keywords—real time mission-critical business intelligence; aromatherapy; personality; quantification theory type 1

I. INTRODUCTION

Aromatherapy product is defined as a product that has essential oils and other aromatic plant compounds which are aimed at improving a person's health or mood [1]. Aromatherapy products, like scrub, soap, perfume, and others product are an individual and very subjective preference which cope high value of business. In common spa service, the therapist usually combines the aromatherapy mixture composition based on their customer personality or emotional condition. They required for rapid responses while fulfill customer need and ordered mixture of active note to serve the customer preferences. Such requirement needs a system in real time condition to ensure effectiveness and efficiency on fulfilling customer need.

Considering this condition, real time decision support gained great attention. Concepts such as active warehousing, real time analytics [2, 3] and real time warehousing became hot topics of interest to firms [4]. Real time mission-critical business intelligence is the way to speed up the flow of information and to deliver information with minimum latency in order to achieve competitive advantage. In other words, it delivers information in a range from milliseconds to a few seconds after the business event. Business Intelligence (BI) is a multi-dimensional concept with collection of tools and techniques that aims to identify information needs and process the data and information gathered into useful and valuable managerial knowledge and intelligence [5].While traditional BI presents historical information to user analysis, real time mission-critical BI compares current business event with historical patterns to detect problems or opportunities automatically [4].

In this paper, we proposed real time mission-critical business intelligence for mixture composition development on aromatherapy product based on the customer personality type. There are two main reasons that make real time mission-critical business intelligence becomes necessary on aromatherapy product development. First, the conditions and environments in which aromatherapy business are unpredictable. Customer preferences change over the time and they require for rapid responses while fulfilling customer needs. Secondly, the implementation of real time mission-critical business intelligence is supported by advances technology, especially the internet and modern information and communication technology so almost all company data source could be made accessible over an intranet and or internet.

The paper objectives are to acquire and formulate customer preference requirement on aromatherapy product in real time mode. We focus on aromatherapy product development especially on aromatherapy perfume and its active notes (top note, middle note, and base note) as the mixture composition. Specifically, in this paper, we discuss the requirement of real time mission-critical business intelligence for aromatherapy mixture composition development based on customer

personality in Section II, quantitative formulation for aromatherapy design based on customer personality type in Section III, computational experiment in Section IV, and conclusion in Section V.

II. Requirement of Real Time Mission-Critical Bussiness Intelligence

A. The Analysis of Real Time Mission- Critical Business Intelligence

The requirement of real time mission-critical business intelligence needs to be analyzed. An analysis can produce a system to improve the efficiency and effectiveness of the system especially in order to formulate the mixture composition of aromatherapy perfume based on customer personality type. Generally, as a system, real time mission-critical business intelligence consists of five components: input, process, output, stakeholders, and key performance indicator (KPI). All components work in its design environment as a boundary system.

This system required customer preferences and product samples as its main inputs. For this purpose, customer preferences were obtained in a real time condition when customer orders a personal product. At the same time product samples were collected per batch in the spa service. This system resulted in two outputs, namely formulation of aromatherapy personal design and aromatherapy market design. The system consists of two stakeholders (customer and spa service) and two KPIs, there are customer preferences and design category score. The environment design of aromatherapy product development is illustrated in Fig. 1.

In this real time mission-critical business intelligence, three databases were available to serve customer profile data, product sample data, and customer preference data. All databases integrated in the data warehouse. From this data warehouse, the proposed system processed the data using QTT-1 method and obtained the information about aromatherapy mixture composition that fits with customer personality type. The design of data flow which transforms data into information is represented in Fig. 2.

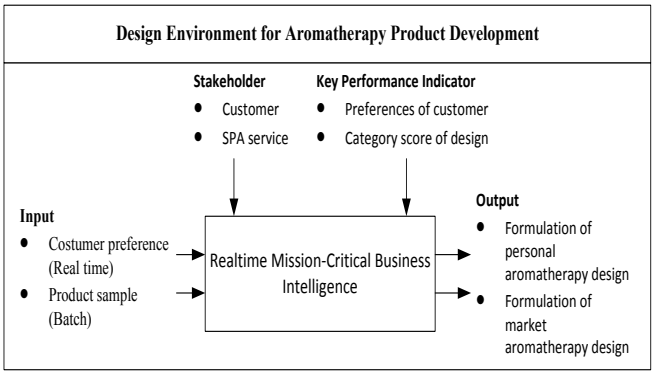

Fig. 1. Scheme of real time mission-critical business intelligence

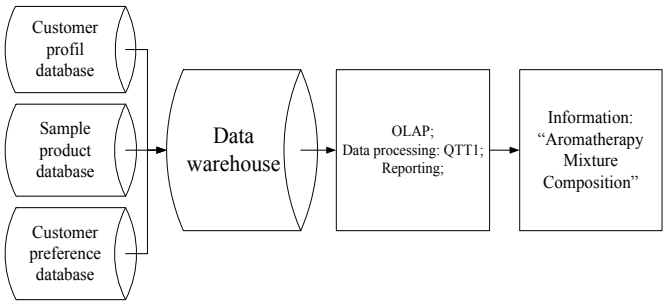

Fig. 2. Design of data flow

B. Data Requirement

The collection of product sample is defined as P_s where $s = 1, 2, ..., k$. Then we identify its Brand (B_s) and mixture composition (X_{ijs}) of i^{th} design element, j^{th} category, and s^{th} sample product. From the identification, we classify the mixture composition into three categories; there are top note (X_{i1s}), middle note (X_{i2s}), and base note (X_{i3s}). The following process classified all product samples into their mixture composition and stored it in sample product database. The data structure of this database is represented in Table 1.

TABLE 1. Data structure of sample product database

No.	Brand	Top note	Middle note	Base note
P_1	B_1	X_{i11}	X_{i21}	X_{i31}
P_2	B_2	X_{i12}	X_{i22}	X_{i32}
...	...	...	...	...
P_k	B_k	X_{i1k}	X_{i2k}	X_{i3k}

In the same time, we collected the customer profile ($Cp_r = Cp_1, Cp_2, ..., Cp_n$) and identify their name (M_r), Gender (G_r = {"male", "female"}), Age (A_r = {integer number}), email (E_r), and also identify their personality (S_{tr}) into four categories (S_{tr} = {"sanguine", "choleric", "melancholy", "phlegmatic"}; where t = 1,2,3,4). All data about customer profiles are saved in customer profile database which is represented in Table 2.

TABLE 2. Data structure of customer profile database

ID	Name	Gender	Age	Personality	Email
C_1	M_1	G_1	A_1	S_{t1}	E_1
C_2	M_2	G_2	A_2	S_{t2}	E_2
...	...	...	...	...	...
C_n	M_n	G_n	A_n	S_{tn}	E_n

The questionnaire which contained data about product mixture composition and customer personality consist each customer inquiry who wants to order the personal product. This step obtained the real time preferences ($Y_{11}, Y_{12}, ..., Y_{nk}$) from customer r^{th} to the product samples s^{th}. This data was stored in customer preference database which is represented in Table 3.

TABLE 3. DATA STRUCTURE OF CUSTOMER PREFERENCE DATABASE

ID	Personality	P_1	P_2	P_3	…	P_k
C_1	S_{t1}	Y_{11}	Y_{12}	Y_{13}	…	Y_{1k}
C_2	S_{t2}	Y_{21}	Y_{22}	Y_{23}	…	Y_{2k}
…	…	…	…	…	…	…
C_n	S_{tn}	Y_{n1}	Y_{n2}	Y_{n3}	…	Y_{nk}

All available data were then fed into QTT-1 formulation to process the data and build the formulation of personal aromatherapy product for each customer inquiry. However, we have to use numerous data to build the formulation of market aromatherapy product to meet the standard number of respondent which can represent the whole customer preference. In the other word, "*if data of customer preference is equal or more than standard, then formulate the market product design based on customer personality*". The standard numbers of respondent were set by using Slovin method (1) as follows.

$$n = \frac{N}{1+Ne^2} \quad (1)$$

Where:
n = sample size
N = number of population
e = level of error

III. QUANTITATIVE FORMULATION FOR AROMATHERAPY DESIGN BASED ON CUSTOMER PERSONALITY TYPE

Aromatherapy design formulation which was based on customer personality type was then obtained as a result of the interaction between customer personality and mixture composition elements. We give a questionnaire to consumers in order to evaluate aromatherapy product based on their preferences. Semantic differential scales (7 scales) were used here. Scale with the two extremes "not like at all" and "like very much".

The results of the evaluation were analyzed by using quantification theory type 1 (QTT-1) method to obtain the aromatherapy design formulation which answers the second objective of this paper. The QTT-1 considered as a quantitative and categorical multiple regression analysis method, which allowed inclusion of independent variables that are categorical and qualitative in nature. The QTT-1 consist of the followings six steps [6]:

Step1: Defining the relational model associated with the measured score of experimental sample with respect to customer preferences. The categorical multiple regression model can be defined as in (2):

$$\hat{y}_s^k = \sum_{i=1}^{E} \sum_{j=1}^{c_i} \beta_{ij} x_{ijs} + \varepsilon \quad (2)$$

Where

$\hat{y}_s^k$ = the predicted value of criterion variable for the s^{th} product sample on the k^{th} image word.
i = the index of design element
E = the number of design element
j = the index of category
C_i = the number of category of the i^{th} design element
ε = a stochastic variable whose expectation value E(ε)=0
β_{ij} = the category score of the j^{th} style within the i^{th} design element
x_{ijs} = the coefficient of the dummy variable

Step 2: Calculating the standardized regression coefficients (4) and standardized constant in model (5). The model of categorical multiple regression analysis can be redefined as (3):

$$\hat{y}_s^k = \sum_{i=1}^{E} \sum_{j=1}^{c_i} \beta_{ij}^* x_{ijs} + \bar{y}_s^k \quad (3)$$

and

$$\beta_{ij}^* = \beta_{ij} - \frac{1}{n} \sum_{j=1}^{c_i} \beta_{ij}^* x_{ijs} \quad (4)$$

$$\bar{y}_s^k = \frac{1}{n} \sum_{j=1}^{c_i} y_s^k \quad (5)$$

Where:

β_{ij}^* = standardized coefficient of explanatory variables
$\bar{y}_s^k$ = standardized constant in model

Step 3: Determining the matrix correlated component regression (CCR) of correlation coefficient of all variables.

Step 4: Calculating the multiple correlation coefficient (R) that is regarded as the relational degree of external criterion variable and explanatory variables.

Step 5: Calculating the partial correlation coefficients (PCC) of design elements that indicate the relationships between product element and a product image.

Step 6: Determining the statistical range of categorical variable which indicates its contribution degree to the prediction model with respect to a given product image.

IV. COMPUTATIONAL EXPERIMENT

A. Identification of Aromatherapy Mixture Composition

There were 15 aromatherapy products (perfume) that were available in particular spa service and in common are classified based on their scent structure. Perfumes have three set notes which composite the scent harmonically; there are top note, middle note, and base note.

Top note perceived immediately upon application of a perfume, top note consist of small, light molecules that evaporate quickly. Middle note is the scent of a perfume that emerges just prior to when the top note dissipate. Base note is the scent of a perfume that appears close to the departure of the middle note. The base and middle note together are the main theme of a perfume. Base note bring depth and solidity to a perfume.

In Table 4, the identification of the aromatherapy included mixture composition (X_{ijs}), where X_{i1s} = {1, 2, 3}, X_{i2s} ={1, 2, 3, 4, 5}, and X_{i3s} = {1, 2, 3, 4, 5, 6, 7}. After the identification of the mixture composition in each product based on their design elements, the result of the classification was presented in Table 5.

TABLE 4. IDENTIFICATION OF AROMATHERAPY PRODUCTS (PERFUME) BASED ON THEIR SCENT STRUCTURE

Type	Scent structure		
	Top note (X_1)	Middle note (X_2)	Base note (X_3)
1	Cajuput	Bay	Balsam Peru
2	Cinnamon	Black Pepper	Cassia
3	Citrus	Cardamom	Cedar wood
4		Chamomile	Cinnamon
5		Cypress	Clove
6			Frankincense
7			Ginger

TABLE 5. CLASSIFICATION OF SCENT DESIGN ELEMENTS

No. Samples	X_1	X_2	X_3
1	2	3	4
2	1	1	3
3	2	5	5
…	…	…	…
15	2	5	6

B. Identification of Customer Personality Type

In this section the customer personality was then indicated by using Hippocrates and Galen theory who classify the personality into four basic personality types: Melancholy, Phlegmatic, Sanguine, and Choleric [7]. These personality types are the most popular and the oldest classification of personality [8]. The classification of the personality is presented in Table 6.

Choleric are considered to be leader and commander types, being dominant, strong, decisive, and occasionally arrogant. Melancholy personality types are described to be the mental types, with their personality displaying a strong emphasis on thinking, evaluation, and assessment. Sanguine are a social personality type, displaying characteristics such as a predisposition to socialize and entertain. Phlegmatic are described as having a flat-type personality, being laid back and desiring a peaceful environment above all else.

TABLE 6. CLASSIFICATION OF THE PERSONALITY TYPE

Personality types	Characteristic of personality
Choleric	Strong, adventurous, powerful, dominant..
Melancholy	Analytical, individualist, details, planner, perfectionist.
Sanguine	Animated, cheerful, humorist, extrovert, trendsetter, sociable.
Phlegmatic	Friendly, easy going, peaceful, shy, adaptable

C. Formulation of Personal Aromatherapy Product Design

First we collected questionnaire for evaluate the existing samples product by customer preference based on their personality. These questionnaires involve 15 samples product and the respondent who order the personal product. There were 7 scales of semantic differential to evaluate the questionnaire. The result of hypothetical data of this questionnaire is presented in Table 7.

TABLE 7. EVALUATING SAMPLES PRODUCTS BY CUSTOMER PREFERENCES

No sample	X_1	X_2	X_3	level of preference
1.	2	3	4	6
2.	1	1	3	2
3.	2	5	5	3
…	…	…	…	…
15.	2	5	6	5
Type of personality				Sanguine

We deploy R language version 3.1.0 [9] on QTT-1 analysis to examine the relationship between the three product scent elements and customer preference. In this paper, 15 independent variables and 1 dependent variable are used. The result of QTT-1 analysis is given in Table 8 and the dashboard is represented in Fig. 3. In Table 8, the highest variable of partial correlation coefficient is “top note”, meaning that “top note” primarily affects the customer’s product preference. The category score of three selected values of the “top note” shows that the consumer’s emotional feeling prefers to “citrus” as a “top note”.

R indicated multiple correlation coefficients which determine how well estimation model fits the observed data and R^2 indicates coefficient of determination which shows how well data points fit a statistical model [10]. R should be more than 0.8 and must be more than 0.6 for an evaluation data model [11]. In this experiment, we obtained that all model has multiple correlation coefficient more than 0.8. This means that the model fits the observed data.

TABLE 8. RESULT OF QTT-1 ANALYSIS

Scent element		Sanguine personal product	
		Category score	PCC
X_1	X_{11}	-1.322	0.980
	X_{12}	-0.017	
	X_{13}	2.678	
X_2	X_{21}	1.823	0.954
	X_{22}	-0.177	
	X_{23}	-0.699	
	X_{24}	-1.786	
	X_{25}	0.084	
X_3	X_{31}	-1.768	0.978
	X_{32}	-2.768	
	X_{33}	-1.420	
	X_{34}	-0.725	
	X_{35}	0.841	
	X_{36}	5.841	
	X_{37}	1.058	
Constant		4.267	
R		0.971	
R^2		0.943	

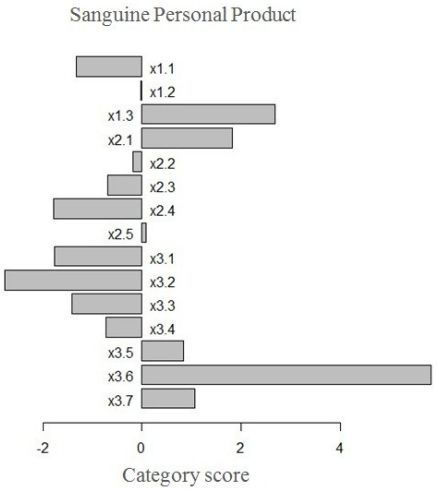

Fig. 3. Dashboard of product personal design

TABLE 9. DESIGN SUPPORT INFORMATION FOR THE NEW AROMATHERAPY PRODUCT DESIGN

Design	Top note	Middle note	Base note
Sanguine personal product	Citrus	Bay	Frankincense

D. Formulation of Aromatherapy Product Design Based on Customer Peronality Type

We collected each data of personal order in our database, so that we can classify them into their personality type and help product designer on developing the new concept design of aromatherapy product for each personality type. In this paper we use hypothetical data. We assume that we have collecting 50 data from each personality category. This means that we have total 200 data from our database. We use the average of 50 data from each personality category. Data of evaluating sample products is represented in table 10.

TABLE 10. DATA OF EVALUATING SAMPLE PRODUCTS

No sample	X_1	X_2	X_3	Choleric	Melancholy	Sanguine	Phlegmatic
1.	2	1	3	3.746	1.901	3.327	2.377
2.	1	3	1	5.238	5.381	4.877	1.998
3.	2	1	7	5.914	3.046	6.798	6.501
…	…	…	…	…	…	…	…
15.	2	5	4	2.474	5.451	5.693	3.920

The QTT-1 method computation was generated by using R Language and the result was represented in Table 11. As seen, the visualization of this result in the dashboard was represented in Fig. 4. From the dashboard, we will know instantly the recommendation of developing the combination aroma on aromatherapy product. The values in each category show the influence level of aromatherapy product. We recommended the highest positive value of category score in each scent category as a scent component in their category.

TABLE 11. FORMULATION OF SCENT COMPOSITION FOR AROMATHERAPY PRODUCTS BASED ON CUSTOMER PERSONALITY

Scent element		Choleric		Melancholic		Sanguine		Phlegmatic	
		Category score	PCC	Category score	PCC	Category score	PCC	Category score	PCC
X_1	X_{11}	0.026	0.929	1.703	0.922	-1.974	0.942	2.148	0.969
	X_{12}	-1.136		-2.497		2.238		-6.098	
	X_{13}	2.221		1.590		-0.528		7.902	
X_2	X_{21}	-0.690	0.930	2.441	0.950	-0.732	0.800	3.490	0.964
	X_{22}	-0.203		-0.599		0.767		-2.955	
	X_{23}	2.537		-0.708		0.485		2.616	
	X_{24}	-0.436		-4.461		0.710		-5.738	
	X_{25}	-0.095		3.716		-1.620		4.923	
X_3	X_{31}	-1.344	0.967	0.282	0.929	1.483	0.957	-6.653	0.969
	X_{32}	-3.598		-4.508		2.210		-8.979	
	X_{33}	2.254		-2.320		-2.281		1.983	
	X_{34}	-0.703		1.194		-0.078		0.579	
	X_{35}	-0.669		0.899		-0.813		0.720	
	X_{36}	-0.098		1.276		2.591		4.517	
	X_{37}	3.332		0.064		0.140		4.593	
Constant		4.020		4.104		4.883		3.888	
R		0.941		0.910		0.943		0.943	
R^2		0.885		0.828		0.889		0.889	

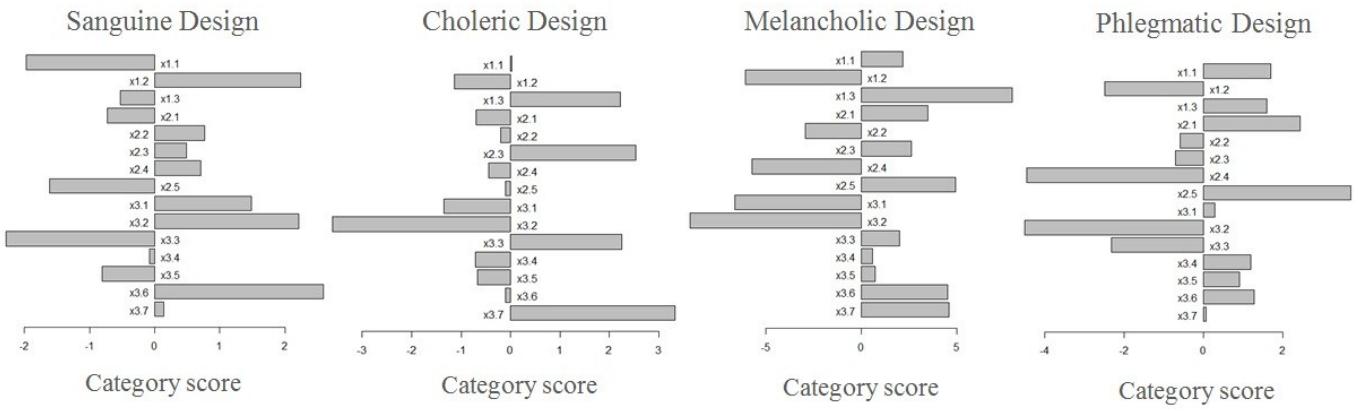

Fig. 4. Design formulation dashboard of each personality

The design support information of the new aromatherapy product design based on customer personality is represented in Table 12. By implementing this system, we can develop the personal aroma formulation of aromatherapy product in real time mode. And we can also develop the aromatherapy product based on customer personality by using all data that we collect from customer order for personal product.

TABLE 12. DESIGN SUPPORT INFORMATION FOR THE AROMATHERAPY PRODUCT DESIGN BASED ON CUSTOMER PERSONALITY

Design	X_1	X_2	X_3
	Top note	**Middle note**	**Base note**
Choleric	Citrus	Cardamom	Ginger
Melancholic	Cajuput	Cypress	Frankincense
Sanguine	Cinnamon	Black Pepper	Frankincense
Phlegmatic	Citrus	Cypress	Ginger

V. CONCLUSION

The result of acquirement from real time mission-critical business intelligence for aromatherapy mixture composition development based on customer personality type showed that the system required two inputs (customer preferences and product samples), two outputs (formulation of both aromatherapy personal and market design), two stakeholders (customer and spa service), and two KPIs (customer preferences and design category score). By using QTT-1 method we obtained the mixture composition formulation which is visualized by the dashboard that accelerates in translating customer preference requirement on aromatherapy product in real time mode. The dashboard generated from KPI ease the decision making on each element in real time mission-critical business intelligence and it could help a spa service to ensure effectiveness and efficiency on fulfilling customer need rapidly based on their personality type.

REFERENCES

[1] A. S. Hutaoit, *Panduan Praktis Aromatherapy untuk Pemula*. Jakarta: GraMedia Pustaka Utama, 2002.

[2] S. Brobst and C. Ballinger, "Active data warehousing," *White Paper NCR Corporation,* vol. EB-1327, 2000.

[3] N. Raden, "Exploring the business imperative of real-time analytics," *Teradata White Paper,* 2003.

[4] B. Sahay and J. Ranjan, "Real Time Business Intelligence in Supply Chain Analytics," *Information Management and Computer Security,* vol. 16, pp. 28-48, 2008.

[5] V. H. Pirttimäki, "Conceptual analysis of business intelligence," *SA Journal of Information Management,* vol. 9, p. 17, 2007.

[6] Y. C. Lin, C. H. Yeh, C. C. Wang, and C. C. Wei, "Is The Linear Modeling Technique Good Enaugh for Optimal Form Design? A Comparison of Quantitative Analysis Models," *The Scientific World Journal,* vol. 2012, p. 13 pages, 2012.

[7] S. T. Vorkapić, "Electrophysiological Differences in Sanguine, Choleric, Phlegmatic, and Melancholic," *The Romanian Journal for Psychology, Psychotherapy and Neuroscience,* vol. 1, pp. 67-96 2011.

[8] I. Lauberte, E. Ginters, and A. Cirulis, "Temperament Identification Methods and Simulation," in *Proceedings of the 11th WSEAS International Conference on Automatic Control, Modeling and Simulation*, Instanbul, 2009.

[9] R. D. C. Team, "R version 3.1.0," ed, 2014.

[10] B. Juanda, *Ekonometrika: Pemodelan dan Pendugaan*. Bogor: IPB Press, 2009.

[11] M. Nagamachi, *Kansei/ Affective Engineerng*. Boca Raton: CRC Press, 2011.