Mahidol University
IT Management, Faculty of Engineering
Wisdom of the Land

IEEE
THAILAND SECTION

MITiCON

The 2nd Management Innovation Technology International Conference

"Technology and Innovation Management for Societal and Global Challenges"

November 16-18, 2015

Bangkok, Thailand

Proceedings

Editor: Sotarat Thammaboosadee

The 2nd Management Innovation Technology International Conference (MITiCON2015)

16-18 November 2015, Bangkok, Thailand

Conference Proceedings

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Welcome Message from the General Chair and Secretary

On behalf of the Organizing Committee, it is our greatest honor to welcome you to the 2nd Management and Innovation Technology International Conference (MITiCON2015), hosted at the Grand Mercure Fortune Bangkok Hotel, Thailand, 16–18th November 2015. MITiCON2015 is supported and sponsored by the Information Technology Management Program, Faculty of Engineering, Mahidol University, co-sponsored by the Graduated Studies of Commerce, Burapha University and supported by several industrial firms. The MITiCON2015 features a world-class conference that brings together researchers and practitioners in the field of management, innovation technology and information technology for the society and global challenges according to the conference theme: "Technology and Innovation Management for Societal and Global Challenges". MITiCON2015 provides an opportunity for academic and industry professionals to present and discuss the latest issues and research progress in the area of technology and innovation management such as IT and innovation management, knowledge management, technology assessment, strategic management, data management, IT corporate management, IT governance, Enterprise Architecture, business management, financial management, economics, policies management, educational management, and their social impacts. Additionally, other related engineering and science topics are also welcome.

This year we received 125 high-quality papers from more than 10 countries. Many papers demonstrated notable systems with empirical analyses. Many of them proposed interesting and outstanding researches in the related fields of innovation management. Each paper was reviewed by two reviewers. Based on these rigorous reviews, MITiCON2015 consequently accepted 73 papers in 7 research tracks for inclusion in the conference program. Therefore MITiCON2015 represents an acceptance rate around to 58%. All accepted

papers will be included in the Proceeding of Management and Innovation Technology International Conference.

The highlights of the conference include:

• Three Keynote speeches by researchers and executive from academic and industry:

- Dr. Smitti Darakorn Na Ayutthaya (Mahidol University), who gives a talk in "Innovation in the Digital Economy for National Policy of Thailand".

- Asst. Prof. Dr. Banpot Wiroonratch (Graduated Studies of Commerce, Burapha University), he provides an academic tutorial in Ph.D. research conduction.

- Ben Gerber (DBS Bank, Singapore), who gives a talk in "Understanding Privacy"

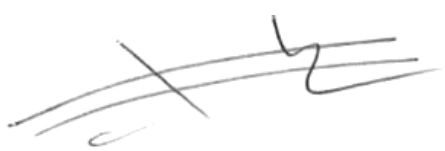
• 10 parallel sessions of international paper oral presentations throughout a two-day period

• 2 parallel sessions of local paper oral presentations on the last day of the conference; and

A series of social functions have been planned, which include a welcome reception, lunches, conference banquet at Grand Mercure Fortune Bangkok Hotel.

Apart from attending the technical program, you are encouraged to experience the magic of the Nightlife City, Bangkok, especially to the Ratchada area which the conference venue is located.

Last but not least, we would like to express our sincere gratitude to everyone involved in making the conference a success. Many thanks go to advisory board members, the organizing committees, the keynote speakers, the program committee and reviewers, the session chairs, the conference participants, and of course, to all the contributing authors who will be sharing the innovation and novelty of their high quality research. We wish our best wishes for an awesome staying in Thailand!



Asst. Prof. Dr. Supaporn Kiattisin
MITiCON2015 General Chair

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MITiCON2015 Secretary

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Keynote Speech

Innovation in the Digital Economy for National Policy of Thailand

Dr. Smitti Darakorn Na Ayutthaya

On behalf of the Royal Thailand Government has pledged to promote the digital economy for transformation. The Ministry of Information and Communication Technology is joining hands with the Federation of Thai Industries in translating the Government's policy on the digital economy into action. Thai economy in 2015 would grow by about 4 percent. The digital economy in the industrial sector, SME operators would be urged to adopt e-business as a new channel for their business operations. "Digital economy" refers to an economy that is based on digital technologies, which are rapidly transforming both business practices and societies. The Thai government is giving a boost to the digital economy in order to enhance the competitiveness of the Thai industrial sector and prepare Thailand for the ASEAN Economic Community. In response to this policy, entrepreneurs and operators of the digital business will be created and developed, so that they will become a driving force for the country's productivity.

Keynote Speech

The Conduct of Dissertation:

The questions must be answered is

how the discovered models can be really used

Asst. Prof. Dr. Banpot Wiroonratch

Mostly research methodology for social sciences are carried out in three steps. 1. What is the original idea? 2. What is the problem found? 3. What the new idea is. Whenever you can answer these questions you can complete you research. Addition, the used sample size and statistic should be suitable as well.

Keynote Speech

Understanding Privacy

Ben Gerber

Data is driving opportunity and increasing quality of life across the world. To realize these opportunities, organizations must demonstrate they are trustworthy and value privacy as a social good by handling data responsibly.

What is privacy? Where do privacy expectations originate from? What does your organization need to do to respect privacy, and meet or exceed the expectations of customers, constituents and regulators? This session will provide the audience with an understanding of international privacy concepts, legal and regulatory requirements and best practices.

Conference Agenda

The 2nd Management and Innovation Technology International Conference (MITiCON2015)

16 - 18 November 2015, Bangkok, Thailand

Grand Mercure Bangkok Fortune Hotel

November 16, 2015		
4:30 pm to 6:30 pm	**Registration and Reception** **Lobby, Fl.1**	
November 17, 2015		
8:30 am to 10:00 am	**Registration and Reception** **Room: Grand Mercure 4, Fl.3**	
9:30 am to 10:00 am	**Opening Ceremonies** **Room:Grand Mercure 4, Fl.3**	
10:00 am to 10:45 am	**Keynote Speech-I** **Presenter:Dr. Smitti Darakorn Na Ayutthaya** **Topic:Digital Economy** **Room:Grand Mercure 4, Fl.3**	
10:45 am to 11:00 am	*Coffee Break*	
11:00 am to 11:30 am	**Keynote Speech-II** **Presenter:Asst. Prof. Dr. Banpot Wiroonratch** **Topic:The Conduct of Dissertation (presented in Thai)** **Room:Grand Mercure 4, Fl.3**	
11:30 am to 1:00 pm	**Lunch** **Location: One Rachada, Fl. G**	
1:00 pm to 5:30 pm	**PRESENTATION**	
1:00 pm to 2:15 pm	**Track-IM1** **Information Technology and Innovation Management** **Session Chair: *Asst. Prof. Dr. Adisorn Leelasantitham*** **Room: Grand Mercure 3, Fl.3**	**Track-EM&PS** **Educational Management &** **Policies Management and Social Aspects** **Session Chair: *Dr. Sarunya Lertputtarak*** **Room: Grand Mercure 4, Fl.3**
1:00 pm to 1:15 pm	**IM-044** IT Management for SCM and Logistics in Agricultural Product Industry *Thongchai Surinwarangkoon*	**PS-026** Personal Factors Affecting Visionary Leadership for Supply Chain Management in the Manufacture Industrial of Thailand: An Empirical Study *Kasem Bunnoiko, Walailak Atthirawong*
1:15 pm to 1:30 pm	**IM-066** Requirement Prioritization for Software Release Planning Based on Customer Value with Analytic Hierachy Process *Alissara Chindapornsopit, Taweesak Samanchuen*	**PS-025** "Facebook" a Dreamlike Stage: Big Data Features, Performance, and Neoliberal Economic Approaches *Sustarum Thammaboosadee, Rubkwan Thammaboosadee, Sotarat Thammaboosadee*
1:30 pm to 1:45 pm	**IM-056** A Truck Tires Usage Worthiness Prediction Model *Nakarin Prateeppattanatumrong, Sotarat Thammaboosadee*	**EM-054** Constructing a Risk Behavior Guideline for Adolescent Students using Decision Tree *Surin Aunsan, Sotarat Thammaboosadee*
1:45 pm to 2:00 pm	**IM-075** The Hierarchical Technology Valuation Model for Big Data Technology Applied in Recruitment *Thiti Noydee, Sotarat Thammaboosadee*	**EM-057** Analyzing the Characteristics of Maths and English Tablet-based Games for Primary School Children *Hsu Nang, Antony Harfield, Ratchada Viriyapong*
2:00 pm to 2:15 pm	**IM-086** Of Online Community: Clustering Group of Compatible Mentor and Mentee *Pratya Nuankaew, Punnarumol Temdee*	**EM-027** A Study of Relationships of Attitudes and Behaviors towards to Usage of Google Translate of IT Students *Onwara Thanongsaksakul, Sotarat Thammaboosadee, Rubkwan Thammaboosadee*
2:15 pm to 2:30 pm	*Coffee Break*	
2:30 pm to 4:00 pm	**Track-IM2** **Information Technology and Innovation Management** **Session Chair: *Emeritus Prof. Lance Fung*** **Room: Grand Mercure 3, Fl.3**	**Track-EM** **Educational Management** **Session Chair: *Dr. Jean Paolo G. Lacap*** **Room: Grand Mercure 4, Fl.3**

2:30 pm to 2:45 pm	**IM-062** Analysis of Global Mobile Device in Thailand *Panyaphat Aekitsawatwikul, Adisorn Leelasantitham, Supaporn Kiattisin, Smitti Darakorn Na Ayuthaya*	**EM-049** Application of BIM into Civil Engineering Management Class *Thoedtida Thipparat, Narong Chaisongkroh, Nonthachart Kulprapa, Thongpoon Thaseepetch*
2:45 pm to 3:00 pm	**IM-055** CRM Strategies discovered by Clustering Technique and Business Intelligence; case study in Chemical Industry *Thanakal Yotsomsak, Sotarat Thammaboosadee*	**EM-050** Application of QFD to Design a Course in Building Information Modeling (BIM) *Thoedtida Thipparat, Narong Chaisongkroh, Nonthachart Kulprapa, Sunantha Srisopha*
3:00 pm to 3:15 pm	**IM-005** Information Format-Shopping Orientation Fit in Mobile Commerce App: A Contradiction between Functional and Psychological Consequences *Chiang-Yu, Cheng, Yu-Tsu Lin, Chih-Wei, Cheng*	**EM-016** The Preparation of Vietnamese Students at Burapha University for Asean Economic Community (AEC) Skilled Labour Market *Chinh Bui Xuan, Saranya Lertbuddharak, Sirinya Chokchaiworarat*
3:15 pm to 3:30 pm	**IM-009** A Web-and-Android-Based Crime Data Retrieval System: A Case Study: Investigation Sub-Division Chiangrai Police Station *Thammavich Wongsamerchue, Wimol San-Um*	**EM-002** A Framework for Empowering Teachers to Author Interactive Content for Tablet Classroom Activities *Siwawes Wongcharoen, Jaratsri Rungrattanaubol, Antony Harfield*
3:30 pm to 3:45 pm	**IM-053** Semantic Ontology for Fine Arts Knowledge Management *Wassana Ouppala, Sotarat Thammaboosadee*	**EM-087** Classification of Basic Computer Skills for Skill Based Online Learning *Sataworn Chaichumpa, Santichai Wicha, Punnarumol Temdee*
3:45 pm to 4:00 pm	**IM-046** The Model Development of Incremental Innovation Affecting Organization Performance of Thailand Furniture Industry *Kitipong Tangkit, Vinai Panjakajornsak*	**EM-052** Univeristy Students' Year Level, Gender, and Entrepreneurial Attitude Orientation: The Case of Management and Entrepreneurship Students of a Philippine Higher Education Institution *Jean Paolo G. Lacap*
4:00 pm to 5:30 pm	**Track-EG** **Engineering, Science, and Technology Management** **Session Chair: *Prof. Dr. B. K. Pal*** **Room: Grand Mercure 3, Fl.3**	**Track-IT1** **Computer Engineering, Computer Science, Information Technology,and Software Engineering** **Session Chair: *Dr. Taweesak Samanchuen*** **Room: Grand Mercure 4, Fl.3**
4:00 pm to 4:15 pm	**EG-068** Occupational Health Hazards Vis-à-vis Industrial Safetyand Environmental Degradation – Case Studies *Dr. B. K. Pal, Sunil Kumar Bisoyi, Deepak Majhi, Susil Kumar Bisoyi*	**IT-061** Efficient Compact Join Algorithm for Acyclic Conjunctive SPARQL *Jaesung Lee, Dongguk Kim, Kyungsun Kim, Hanmin Jung*
4:15 pm to 4:30 pm	**EG-071** Optimal routing model for multi modal transportation *Thanawat Bamrungthai, Supaporn Kiattisin, Smitti Darakorn Na Ayuthaya*	**IT-070** A Development of Efficient Routing Algorithm Applied in Transportation Networks *Tun Tun Naing, Sunantha Sodsee*
4:30 pm to 4:45 pm	**EG-063** The Development of Distributed Sensors Network for Measurement of Thermal Comfort in Academic Classroom *Wipawadee Wongsuwan, Wimol San-Um*	**IT-065** A Verification of Instantaneous Acoustic Emission Signals Based on ASTM E976-94 Standard through Short-Time Fourier Transform Method *Jirayu Samkunta, Wimol San-Um*
4:45 pm to 5:00 pm	**EG-001** A Structural Equation Model Development of Environmental Performance and Economic Performance of The Electrical and Electronics Industry in Thailand *Surin Wichchuwong, Vinai Panjakajornsak, Amnuay Saengnoree*	**IT-064** An Image Encryption Scheme and Its Android Application using Robust Chaotic Map with Absolute Value Nonlinearity *Sivapong Nilwong, Wimol San-Um*
5:00 pm to 5:15 pm	**EG-038** Application of AHP and VIKOR for Chemical Product Selection *Thoedtida Thipparat, Narong Chaisongkroh*	**IT-039** Emotion Recognition using EEG data with a Multiple Classification Framework *Anuchin Chatchinarat, Chun Che Fung, Kok Wai Wong*
5:15 pm to 5:30 pm	**EG-051** 4D Application for Energy Building Project *Thoedtida Thipparat, Narong Chaisongkroh*	**IT-032** Improving Classification Performance with Complementary Fuzzy-Based Neural Networks *Ratchakoon Pruengkarn, Chun Che Fung, Kok Wai Wong, Worapat Paireekreng*
5:30 pm to 5:45 pm	**EG-090** Design of Thermoelectric-Based Cooling System used for Portable Application *Teerapon Thongpasri, Surapong Pongyupinpanich*	
6:30 pm to 8:30 pm	**Evening Reception** **Location: Rim Suan, Fl.12**	

November 18, 2015	
8:30 am to 9:00 am	**Registration and Reception** **Room: Grand Mercure 4, Fl.3**
9:15 am to 11:45 am	**MORNING PRESENTATION**

9:15 am to 10:30 am	**Track-EA&IT** **Enterprise Architecture, IT Corporate Management, and IT Governance** **Session Chair: *Prush Sa-Nga-Ngam*** **Room: Grand Mercure 3, Fl.3**	**Track-BM1** **Business, Marketing, Strategic, and Financial Management** **Session Chair: *Asst. Prof. Dr.Yordying Thanatawee*** **Room: Grand Mercure 4, Fl.3**
9:15 am to 9:30 am	**EA-030** The Factors Affecting to Acceptable Behaviors of Enterprise Resource Planning *Mathuros Panmuang, Chonnikarn Rormorn, Khuanwara Potiwara*	**BM-010** The Use of Social Media for Corporate Disclosure by Companies Listed in the GCC *Ehab K. A. Mohamed, Mohamed A. K. Basuony*
9:30 am to 9:45 am	**EA-074** Economic Analysis of the Information System Investment Using Cost and Benefit Analysis (CBA) Method *Leo Willyanto Santoso, Yulia, Imelia Widjanadi*	**BM-014** A Study of the Core Competencies Affecting the Performance of Security Investment Consultant at Security Companies in the Stock Exchange of Thailand *Phatre Friestad*
9:45 am to 10:00 am	**EA-076** IT Investment Evaluation Using Multi Objective Multi Criteria: Case Study on an Expedition Company *Yulia, Leo Willyanto Santoso, Danny Tantra*	**BM-034** Employee or Employer? Entrepreneurial Perspectives of Tourism Management Students of a Higher Education Institution in Angeles City, Philippines *Darriel B. Mendoza, Jean Paolo G. Lacap*
10:00 am to 10:15 am	**IT-077** Towards an Internet-of-Things aware Process Modeling Method - An Example for a House Suveillance System Process Model *Roland Petrasch, Roman Hentschke*	**BM-060** A Structural Equation Model Development of Service Quality, Brand Image, and Switching Deterrents Affecting Customer Loyalty for Mobile Service Providers in Thailand *Patcharanan Klankaew, Amnuay Saengnoree, Vinai Panjakajornsak*
10:15 am to 10:30 am	**IT-033** Management of Internet Bandwidth Using Machine Learning Technique *Hari Suparwito, Hong Xie, Chun Che Fung, Shri Rai*	**BM-045** The Role of Regulatory Focus on Promotional Mental Accounts *Pei-Ru, Li, Po-Shun, Chen, Chia-Jung Chang*
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10:45 am to 12:00 am	**Track-IT2** **Computer Engineering, Computer Science, Information Technology,and Software Engineering** **Session Chair: *Dr. Sotarat Thammaboosadee*** **Room: Grand Mercure 3, Fl.3**	**Track-BM2** **Business, Marketing, Strategic, and Financial Management** **Session Chair: *Dr. Supasit Lertbuasin*** **Room: Grand Mercure 4, Fl.3**
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11:00 am to 11:15 am	**IT-079** Comparison Between Shape-based And Area-based Features Extraction for Java Character Recognition *Rudy Adipranata, Gregorius Satia Budhi, Liliana, Bondan Sebastian*	**BM-040** A Causal Model of Innovation Capability, Market Orientation and Absorptive Capacity Affecting Competitive Advantage of Thailand Rubber Industry *Prapapan Mantam, Vinai Panjakajornsak*
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12:00 pm to 1:00 pm	**Lunch** **Location: One Rachada, Fl. G**	
1:00 pm to 1:30 pm	**Keynote Speech-III** **Presenter: Ben Gerber** **Topic: Understanding Privacy** **Room:Grand Mercure 4, Fl.3**	
1:45 pm to 4:15 pm	**LOCAL PRESENTATION (Thai Tracks)**	
1:45 pm to 4:15 pm	**Track-TT1** **Thai Track I** **Session Chair: *Manutsiri Chansutthirangkool*** **Room: Grand Mercure 3, Fl.3**	**Track-TT2** **Thai Track II** **Session Chair: *Dr. Taweesak Samanchuen*** **Room: Grand Mercure 4, Fl.3**
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2:45 pm to 3:00 pm	*Coffee Break*	
3:00 pm to 3:15 pm	**TT-081** การเปรียบเทียบคุณลักษณะและประสิทธิภาพเครื่องแม่ข่ายเสมือนแบบก้อนเมฆของศูนย์ข้อมูลกลาง Uninet ระหว่าง ยูคาลิปตัสคราวด์และไมโครซอฟท์ซิสเต็มเซ็นเตอร์ 2012 *ศรุต จันทร์ไกร, สุภาภรณ์ เกียรติสิน, อดิศร ลีลาสันติธรรม, สมิทธิ์ ดาราภร ณ*	**TT-089** การวิเคราะห์สมรรถนะการทำงานของโรงไฟฟ้าพลังงานร่วม: กรณีศึกษา *อัญชิตา จิตตามัย, สุเมธ เนติสัตตานนท์*
3:15 pm to 3:30 pm	**TT-004** การเปรียบเทียบประสิทธิภาพการทำงานของ Extract, Transform and Loading (ETL) โดยใช้ต้นไม้การตัดสินใจและตรรกศาสตร์คลุมเครือ *ณัฐพล นาคบัวแก้ว, สุภาภรณ์ เกียรติสิน, อดิศร ลีลาสันติธรรม, โษฑศรัตต ธรรมบุษดี สมิทธิ์ ดาราภร ณ อยุธยา*	**TT-018** มาตรฐานการบริการคนไร้ที่พึ่งนนทบุรี ในสถานแรกรับคนไร้ที่พึ่งนนทบุรี *ณัฐสิมี วรัตน์กลบันทร์, นพดล เดชประเสริฐ*
3:30 pm to 3:45 pm	**TT-023** การบริหารจัดการที่ส่งผลต่อการมีส่วนร่วมในการพัฒนาสถานทำงานน่าอยู่ น่าทำงานของพนักงานและข้าราชการ สำนักนโยบายและยุทธศาสตร์ สำนักงานปลัดกระทรวงสาธารณสุข *สโรชิน สหสาคร, สุชนนี เมธิโยธิน*	**TT-022** แนวทางการปฏิบัติงานในการเข้าถึงมวลชนของหน่วยทหารระดับกองร้อยในพื้นที่หน่วยเฉพาะกิจยะลา ระหว่างปี 2552 - 2557 *วาทินี สุวรรณรักษ์, สุชนนี เมธิโยธิน*
3:45 pm to 4:00 pm	**TT-091** การลดสัญญาณรบกวนข้ามช่องใน VLSI Design โดยใช้ทฤษฎีกบกระโดด *อดิศักดิ์ จีบคำพล, นุสรา ฮวดโพธิ์พันธ์, อภิชาต ดีรประเสริฐสิน*	**TT-092** การจัดวางโครงสร้าง VLSI Chip เพื่อลดเส้นทางการเชื่อมต่อโดยใช้ทฤษฎีกบกระโดด *วิไลพร แหว่กระโทก, สิทธิพงศ์ ชวนโพธิ์, พรภัสสร อ่อนเกิด, อภิชาต ดีรประเสริฐสิน*
4:00 pm to 4:15 pm	**TT-094** Designing the Governance and Measurement Model for Thailand Mobile Connect Service by Utilising the TM Forum eTOM and ISO 38500 Framework *Mahasak Pijittum, Supaporn Kiattisin, Smitti Darakorn Na Ayuthaya*	**TT-093** การออกแบบจัดวางผังโรงงานเพื่อลดขั้นตอนการเดินทางโดยใช้เทคนิคซัฟเฟิลฟรอกลิปปิง *อนัญญา ศรีวงษ์, สิรินทิพย์ วันจันทึก, ประกาย นาคี, อภิชาต ดีรประเสริฐสิน*

Implementing Historical Aspects of Majapahit Empire in A Turn Based Strategy Game

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***Abstract*—Introducing a nation to the outsider is to introduce the history of the nation. History is an identity, pride and the origin of a nation. If we want to know a nation, then we will find out the history of the nation first. From the nation's history, we will understand what kind of life values upheld by the people and also their culture.**

Game is a media that is easily understood by people of all ages and easy to understand all the nations because they do not involve a certain language. Games also have standard and simple rules which are easy to be understood. With these advantages, a game is a medium which is suitable for presenting history of a nation to the world. At the same time, as a means to introduce the nation's history to its own citizens in interesting ways. Game strategy is chosen because it would give players an experience. This experience is an effective way to take someone on an understanding of the conditions which are experienced. Therefore, building a game that simulates an experience of the history of the nation is an effective way to guide the future generation to understand and appreciate the values of existing as well as maintaining the good things that have been championed by his predecessor.

This paper describes a game which simulated an important history of Indonesia. This game will give its players an experience how to conquer all the kingdoms in Indonesia at Majapahit time. Majapahit conquered almost the same area as modern Indonesia. So, Majapahit can be a representation as Indonesia at the ancient time. The main goal of this game is how to make the player understand that Indonesia, contains many people groups, will be unite if we have a common goal and not only surpass other groups but also keep all the group save from enemies from outside region.

The aim of this game is to present political system, socio-cultural and trade in the era of the Majapahit as background preparation of a strategy to unite all regions in Indonesia. These aspects impact each other and still have influent upon modern Indonesia. So, this game can be a representation of Indonesia.

Keywords—Historical Aspect, Majapahit Empire, Turn Based Strategy Games, Majapahit's conquest

I. INTRODUCTION

History is important because it explains the civilization and culture of a nation. The fame of a nation can be seen from its history. However, studying the history often becomes difficult because there are only few historical sources, such as artifact, history documentation, or culture sites. Another obstacle in introducing history to the next generation is the lack of interesting and interactive media to represent the history. In information technology era, if only rely on print media such as text book, will be less desirable for IT generation. For this generation, multimedia such as game is more potential and powerful [1][2][3].

Many countries present their history on many kinds of media. Appropriate media which make history accepted more easily [2]. Therefore, not only their own people who interested to know and learn national history, but also other nations will be interested to know more deeply. Multimedia used are picture books, movies, cartoons, dramas, and games.

In the case of Indonesian history, there many kingdoms rose and fall. Some kingdoms became powerful kingdoms and expand their territory almost the entire territory of Indonesia today, such as Sriwijaya, Mataram, Singasari and Majapahit [4][5]. One of the great empires that ever existed in Indonesia is Majapahit.

In its heyday, Majapahit controlled the area that similar to Indonesia's area today [4][5][6][7]. Administrative center was located in East Java, with its capital city, Mojokerto. Majapahit is an agricultural country and had a strong maritime. Not only the region, but the governance and socio-economic structure of society are also similar to the people of Indonesia today. Therefore, Majapahit kingdom Indonesia can be regarded as representation of the Indonesian history.

In this research, we developed a strategy game with the theme of the history of the kingdom of Majapahit. The main purpose of the making of this game is to present a glimpse of Indonesia's history to the next generation using interesting and interactive multimedia. The main objective of this game is not to explain the history, but to raise an interest to study the history deeper.

In developing a game, the plot is in the hands of players [8]. Therefore, presents the history in chronological order is impossible to do [9]. Players also need to be directed at a specific goal to be accomplished in the game. These two things will be major concern in the game design.

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II. THEORY

A. Strategy Game

Strategy game is a game genre that emphasizes thinking and good planning to achieve goal [10]. Players must plan a series of actions against one or more enemy and trying to weaken the opponent with as efficiently and quickly as possible. There are various actions the player can take, such as doing the construction, set up resources or preparing a defense to face the enemy attack. A strategy games take the challenges from AI's strategy which adopted from the opponent leader personality. Most of the game involves an element of war strategy, and give priority consideration a combination of tactics and strategy. This kind of game is often challenging the ability of players to explore and regulate the economy. In strategy games, the main purpose of the session of the game is to beat all the other players and become a winner.

Game strategy is generally subdivided into two subgenres, which is turn-based strategy and real-time strategy. In subgenre turn-based, players can only run the action on the turn only. Actions can be taken are limited, for example, the player can only do two actions on their turn. Turn-based strategy provides flexibility to the players to think without being limited time. While the real-time strategy, game run without a turn. All actions are done by player and AI in the game will have a direct impact on the course of the game. This subgenre encourages players to think fast and concentrate on the game.

B. Game Based Learning for Learning History

Zin, Jaafar, and Yue mention that using learning games could help students in some subjects such as history [2]. There are several factors that must be considered in making game, such as

• Background Story on Game needed to recount events that happened in history. The event consists of the time and location.

• Rules of the Game necessary for the player to follow the existing gameplay[2]. Rules of the game are also important to deliver the value to players [11].

• Immersive: Game design that there should be able to make players feel involved in the events that occurred on each gameplay.

• Enjoyment: The pleasure in playing the required player so that the player still wants to play the game there [3].

• Feedback: Feedback is required by a player to give a clear interaction with the game being played.

• Technology Multimedia: The Role of 2D or 3D multimedia necessary to draw the attention of the player [12].

• Competition and Challenge in the game should be able to adjust to the capabilities player that plays.

• Reward or acknowledgment required by the game so that the player keen to continue to play games created.

C. Designing A Game

Game designing is a process by which developers plan a game they will make. The process consists of several steps, beginning with imagining the concept of the game and defining how the game works, and planning elements that will build the game. At the planning concept of the game, the designer suggested that adheres to a philosophy of work focused. In game design, there is a philosophy called player-centric game design. This philosophy is a design concept in which to design a game, the designer had to imagine beforehand exactly the type of candidate the player / target audience for these games [8]. From there, the designers had to hold on a few things during the game design

• Creating an entertaining game. The main objective of the game is to entertain players. Therefore, if there is a feature or concept in the game as opposed to this, the feature should be abolished.

• Creating a player orientation game, not according to what designer wants. To achieve this, designers have really imagined himself as a candidate for player of the game that will be created.

After planning the concept games, designers can start designing components of the game. There are two main components that are required in every game, the core mechanics and user interface [8]. Core mechanics is a set of rules that would be the basis of a gaming system. Rule can be simple as how quickly the player character is running, or the more complex as what action will be taken when player meets the enemy. User interface will be a bridge between the players with the core mechanics. User interface captures input from the player and turn it into action. Action is then received by core mechanics. Core mechanics of the action process and send the results back to the user interface. Then, user interface accepts the result and display it as an output that can be understood by the player.

III. GAME DESIGN

The game developed in this research is called Majapahit Conquest. The important thing designing this game is determining what is the goal the player should achieve and how does he achieve it. The goal of this game is conquer kingdoms at Indonesia archipelago. In the real history, this mission is important for Majapahit. In order to survive from Mongolian attack, all kingdoms in the same territory should unite. Otherwise, the Mongolian will be easy to attack Majapahit or other kingdom by making alliance with one of the kingdoms.

A. Goal of Game

The next step in this game developing is designing how the player can conquer all the other kingdoms. To achieve the goal, the player should arrange his strategy. Determine how many troops and what kind of troops he will send to conquer a kingdom. If the kingdom weaker than the player's, it will be subject to Majapahit (the player's kingdom). Some neighbor kingdom will be subject to Majapahit with fight, some others with peace, based on their army power. Figure 1 show the

relationship diagram of what supports the important component in achieving the goal.

B. Game Rule

The main component to conquer other kingdom is how many and how powerful the troops. Majapahit has a great marine corps. Not only marine, it also has army. To have such a great troops, first recruit people, train them and send them. The number of populations shown in the game is the productive people. 5% of them can be recruited as troops. 20% will be bureaucrat, 40% farmer, 20% merchants, 15% industry worker. Every year the population will increase by 0.2% - 1% depend on the food supply. To train the recruited people, army base is needed. This army base has capacity. To build an army base needs enough money. The government gets the money from taxes, livestock, industries and trading. Government also takes tax from field but not paid with money but with grain.

To send the troops to other kingdom, weapons and or ships are needed. Weapons are supported by metal industries and ships are built by ship workers. Both metal industries and ship workers should be paid some amount of money. Raw material of metal can be taken from certain regions which are metal mines in Indonesia until now.

The basic component needed by all the population, worker, and troops, is food. Commonly, an Indonesian eats approximately 100 kg per year. The harvest will fulfill the need of grain for the entire population. Normally, Indonesia gets 4-5 tons per hectar, twice a year in Majapahit time [6]. If the government support the farm with good irrigation, with build dams, use good technologies, it will yield abundant corps. If farming starts lately, the harvest will fail. If there surplus of rice, it will be trade for spices (from Maluku), ceramics, silk and metal utensils (from China, Thailand or Arab). The key of getting successful harvest is irrigation. To have good irrigation, should build dams. The others way to have a good harvest are technologies such as plow, hoe, and anticipating pest. In Indonesia, there are 8 kinds of pest in 8 years which come periodically [6]. If the anticipating action is wrong, the harvest result will reduce by half. Technically, rice filed would be available if the government clearing forests, cultivating the land using technology. Once a rice field is opened, a number of the population will automatically be allocated as farmers.

Trading only can run if government builds the market places. The market places are only can be built on certain locations, based on history. They are Curabhaya, Trung and Canggu, the name of modern cities are Surabaya, Gresik and near Mojokerto respectively [6]. The harbors should be built on those Tuban, Gresik and Surabaya as three major harbors in Majapahit. The commodity also based on history. The grain will be trade for spices and sandalwood from East Indonesia. Later the spices and sandalwood will be trade for garment, ceramics and silk. Metal industries only run on two cities, Jember (Kendeng Lembu) and Pacitan (Punung).

The government takes money from the tribute from subordinate kings and taxes [6]. Taxes collected include taxes on land, trade, property taxes and transportation, natural resource tax, industries and taxes from farming in the form of grain. At the time of Majapahit, the land has a value and an important role for the community, any land owned should be best utilized or will be fined. Land tax levied based on several criteria, namely the type of soil and land area. Trade tax assessed on the amount of goods carried. Handicraft business tax is taken by the base material objects that craft, metal or nonmetal materials.

Tax collection time is varies, monthly, pratiwarsa (yearly), twice a year (for example, every full moon Jyestba and Caitra, in farming case), each full moon in the month Asadha (June-July), each Asuji (September- October), every month Karttika (October-November) and so on. Every kind of taxes have its own time to be taken. There is a tax-free area to the kingdom called sima area. If an area designated as an area sima, tax collection was not handed over to the kingdom, but used for the construction and maintenance of sacred buildings in the area [6].

C. Game World

The last step in designing this game is developing the story and creating the game world. The story will begin at year 1293 when Majapahit's history started. This game is based on turn. Every turn is a month in agricultural calendar. These months are not composed the same number of days [6]. Some have just half than the longest months. This calendar system is chosen because Majapahit is an agricultural kingdom and also match the season in Indonesia till this day. At the first time, player will be given a region (the region of Majapahit's capital city), an amount of money and some people. Player can choose at most one action on each aspect. The aspects are based on the diagram on Figure 1, troops, food, trading and money. It means do anything with the troops, determine what to do with the farm and make trading with other area or other kingdom and collect tax. To execute the actions, player should end his turn. After that, other kingdoms will take some actions too. The other kingdoms will be controlled by AI system.

Figure 2 show the map will be used. Since the center of Majapahit kingdom is in Java, so the game will only shows Java with little part of other kingdoms.

IV. CONCLUSION

Implementing history aspect into a strategy game should concern some significant things, such as the goal of the game, how the player can achieve the goal, the game rule and actions the player can choose. Not all ancient life styles can be modeled because it will limit the player to take the action on the game. The aspect can be modeled are the important aspect that support the goal of the player. In the case of Majapahit's history, the important aspects are territorial expansion and agriculture. The other aspects that support player to achieve the goal are the strength of the army, food supplies and financial.

Strength of army can be reach by train the troops, enlarge the army base and multiply weapon and ship for war preparation. Food supplies can be gotten by open forest and make it field, build irrigation, use farm technology and handle the pest correctly. Start planting rice in the right time. Money come from taxes. The government should collect the right tax

on the right time. Through all these actions, player will have an experience similar with ancient life.

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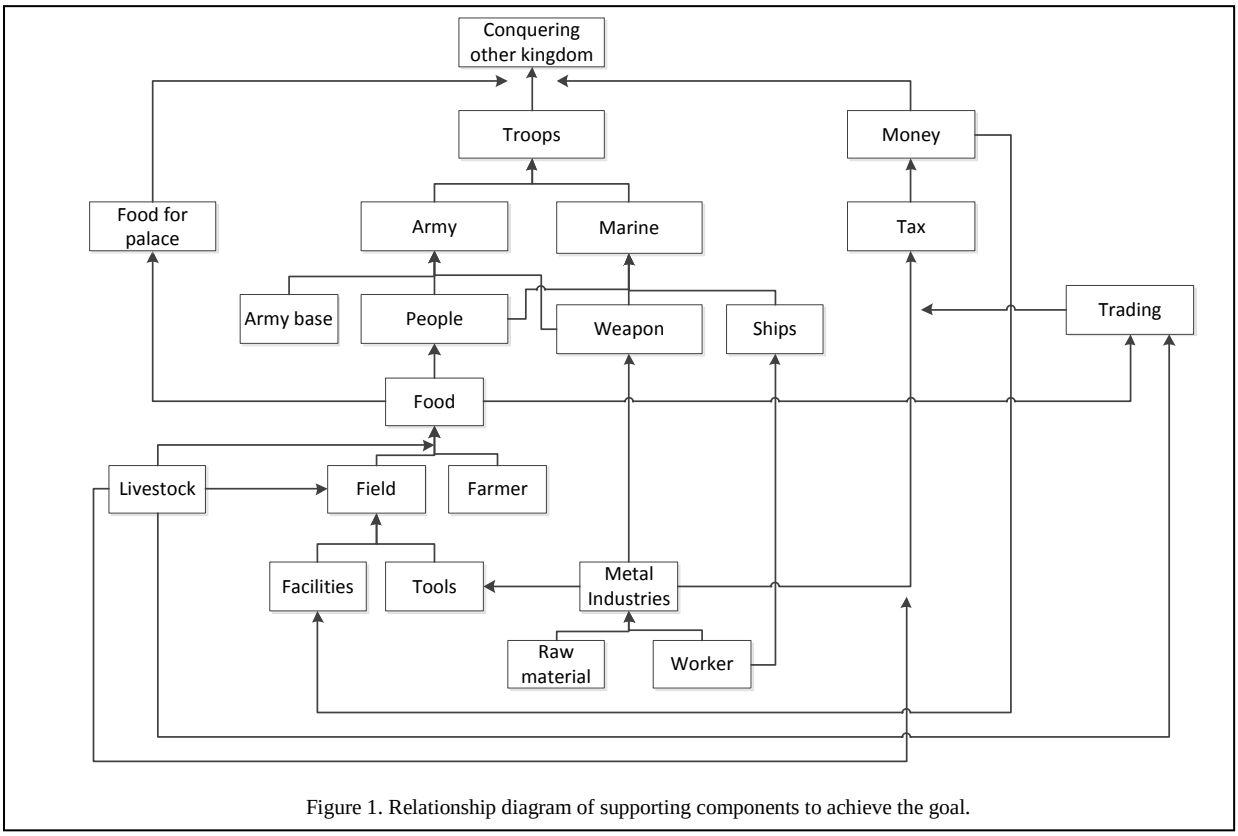

Figure 1. Relationship diagram of supporting components to achieve the goal.

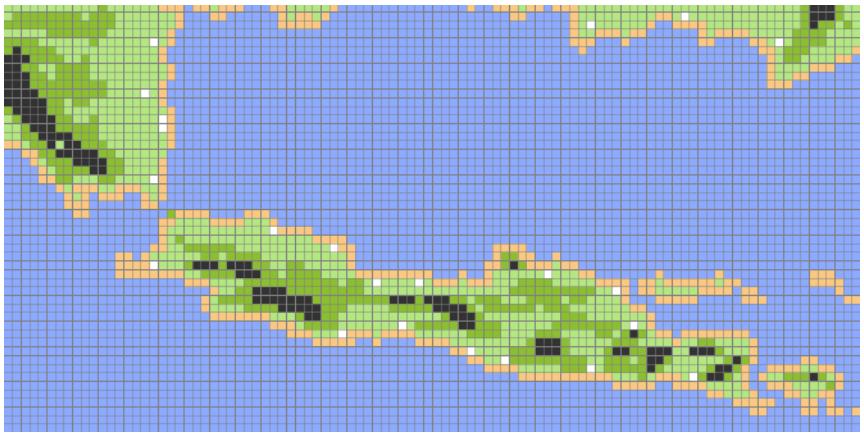

Figure 2. Game Map, Java's landscape

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ดำรงพล ชนะวรรณ	มหาวิทยาลัยมหิดล	Thailand
ตุลย์ ไตรยสรรค์	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าธนบุรี	Thailand
เทอดพงษ์ แดงสี	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าพระนครเหนือ	Thailand
ธีทัต ตรีศิริโชติ	มหาวิทยาลัยบูรพา	Thailand
นพดล เดชประเสริฐ	มหาวิทยาลัยบูรพา	Thailand
นุจรี ภาคาสัตย์	มหาวิทยาลัยบูรพา	Thailand
นุสรา ฮวดโพธิ์พันธ์	มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน	Thailand
ประกาย นาดี	มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน	Thailand
พงษ์พิสิฐ วุฒิดิษฐโชติ	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าพระนครเหนือ	Thailand
พรพรรณ รักนาค	มหาวิทยาลัยบูรพา	Thailand
พรภัสสร อ่อนเกิด	มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน	Thailand
ภูวรินทร์ นิลรังษี	มหาวิทยาลัยบูรพา	Thailand
เยาวลักษณ์ วรกานต์ทิวัตถ์	มหาวิทยาลัยบูรพา	Thailand
รวี อาณานุการ	มหาวิทยาลัยบูรพา	Thailand
เรียม เขียนทอง	มหาวิทยาลัยบูรพา	Thailand
วาทินี สุวรรณรักษ์	มหาวิทยาลัยบูรพา	Thailand
วิไลพร แหว่กระโทก	มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน	Thailand
วีรพล จิรจริต	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าธนบุรี	Thailand

Name	Organization	Country
ศรุต จันทรไกร	มหาวิทยาลัยมหิดล	Thailand
ศักดิ์ชาย จันทร์เรือง	มหาวิทยาลัยบูรพา	Thailand
โษฑศ์รัตต ธรรมบุษดี	มหาวิทยาลัยมหิดล	Thailand
สมิทธิ ดารากร ณ อยุธยา	มหาวิทยาลัยมหิดล	Thailand
สโรชิน สหสาคร	มหาวิทยาลัยบูรพา	Thailand
สิทธิพงศ์ ชวนโพธิ์	มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน	Thailand
สิรินทิพย์ วันจันทึก	มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน	Thailand
สุชนนี เมธิโยธิน	มหาวิทยาลัยบูรพา	Thailand
สุชนนี เมธิโยธิน	มหาวิทยาลัยบูรพา	Thailand
สุชนนี เมธิโยธิน	มหาวิทยาลัยบูรพา	Thailand
สุภาภรณ์ เกียรติสิน	มหาวิทยาลัยมหิดล	Thailand
สุเมธ คำงำเมือง	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าธนบุรี	Thailand
สุเมธ เนติลัดดานนท์	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าธนบุรี	Thailand
อดิศร ลีลาสันติธรรม	มหาวิทยาลัยมหิดล	Thailand
อติศักดิ์ จีบค้างพลู	มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน	Thailand
อนัญญา ศรีวงษ์	มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน	Thailand
อภิชาต ติรประเสริฐสิน	มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน	Thailand
อัญชิตา จิตตามัย	มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าธนบุรี	Thailand

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