Integration of TOGAF 9.1 ADM in Enterprise Architecture
Smart City Design in the Tourism Domain with ISO 27001

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Abstract. The purpose of this research is to create an enterprise architecture design smart city that has a high-security system in the tourism domain that includes smart experiences, smart destinations, and smart business ecosystems. The method used in this research was integrating ISO 27001 as an international information security standard on the TOGAF 9.1 ADM used as a framework for designing enterprise architecture. The result of design can improve Quality Assurance (QA) of the IT information security system, increase IT and business alignment and increase security awareness among government, tourists, industries, and the local community. Business Architecture focuses on centralized coordination by the board and evaluation of the performance of tourism stakeholders; Analysis results of data collection into information and useful on architecture or stakeholders; while application architecture has a focus on developing applications for tourists, business entities, and government monitoring; The technology architecture as the supports to the implementation of research with a data center, cloud service, and transaction interface that is given NFC technology. The result of this research is a smart city enterprise architecture design with a tourism domain that can be implemented in a smart city area and has a security system architecture after phase D of Requirements Management TOGAF 9.1 ADM with a higher security level.

1. Introduction
Smart City as a concept strategically for introduces Information and Communication Technologies (ICT) [1], digital and telecommunications in a flexible, efficient and sustainable in order to improving Quality of Life (QoL) of citizens [2, 3] by conducting basic monitoring of the state of the city information processing and the provision of various services using information systems [4, 5]. Indonesia plans to turn metropolitan cities into smart cities in 2045 [6]. Indonesia has a variety of tourist destinations that are managed by the city government, but the challenges faced are the management system, monitoring basic services, visitor information [7] and the use of technology that is still semi-conventional are not yet integrated. The smart economy is one of the clusters in a smart city that can be realized with smart tourism that has indicators of smart experiences, smart business ecosystems and smart destinations [6, 8]. The utilization of new technologies such as wireless technologies (e.g WiFi, ZigBee, Bluetooth, WiMax, Wireless Sensor Networks (WSN), 4G or LTE (Long Term Evolution)) [9] Internet of Things (IoT) [10, 11], Near Field Communication (NFC) possibility to smartphones and other mobile devices to become mobile wallet, mobile payment, mobile ticketing and location-based services [8], direction to location tourism with Geographic Information Systems (GIS) [12, 13] as well as guaranteeing high safety standards as a requirement analysis applied in this smart tourism architecture enterprise design [10]. The guarantee of an Information Security Management System (ISMS) [14] consists of policies, procedures, guidelines, and related resources as well as activities that are collectively managed in smart tourism to protect technology and information assets that are managed [15]. The purpose of this research is to create an enterprise architecture design smart city that has a high-
security system in the tourism domain that includes smart experiences, smart destinations, and smart business ecosystems using the Design Research Methodology (DRM) approach.

2. Method

2.1. DRM (Design Research Methodology)
The research method used the Design Research Methodology (DRM) approach with the aim that the research is more effective and efficient. DRM includes 4 stages: 1. Research clarification to find evidence and describe current conditions and development plans; 2. Descriptive study I is the stage to find out what factors influence and determine the intended factors; 3. Perspective study is a stage to correct and elaborate the desired conditions; 4. Descriptive study II is a stage to determine the impact and evaluation of the application of the developed solution \[16\]. In this paper, the second and third stages will be explained.

2.2. TOGAF ADM Framework
Enterprise architecture design is designed by following the pattern systematically from a Framework for Enterprise Architecture Planning (EAP) \[17\]. The EAP Framework often used is Zachman Framework for Enterprise Architecture, The Open Group Architectural Framework (TOGAF), Federal Enterprise Architecture Framework (FEAF), Value Realization Framework (VRF) / Simple Iterative Partitions (SIP) \[18, 19\].

Some research proposes the application of the TOGAF framework in making the smart city IT master plan \[6, 20\] in Indonesia with improvements to IT architecture. This smart tourism architecture design refers to the organizational structure of Indonesian Ministry Tourism and the Department of Bandung city tourism \[21\].

The TOGAF framework defines Enterprise Architecture in four domains \[22\] (see Figure 1):

1. Business Architecture: Structure and interaction between business strategies, organizations, functions, business processes, and information needs.
2. Data / Information Architecture: Structure and interaction of all types and sources of data belonging to the organization, logical data assets, physical data assets, and data resource management.
3. Application Architecture: Structure and interaction of application as the capabilities of a group that provides core business functions and manage data assets.
4. Technology Architecture: Structure and interaction of platform services, as well as the physical and logical aspects of the technology components
ADM (Architecture Development Method) is the core of the TOGAF framework that can be described in the Architecture Enterprise development cycle, in this study a comprehensive design will be made up to Phase D (Architecture Technology). There are 10 phases in TOGAF which can be seen in Figure 1:

1. Preliminary Phase:
   This phase describes the preparation and initiating activities

2. Phase A: Architecture Vision
   This phase describes the initial phase of ADM. Includes information on determining the scope, identifying stakeholders, creating an Architectural Vision and getting approval

3. Phase B: Business Architecture
   This phase describes the development of Business Architecture to support the approved Architecture Vision.

4. Phase C: Information System Architecture
   This phase describes the information system architecture for the architecture project, which covers the development of data and application architectures

5. Phase D: Technology Architecture
   This phase describes the development of Technology Architecture for architectural projects

6. Phase E: Opportunities and Solution
   This phase describes the process of identifying effective solution delivery, architectural targets that have been identified in the previous phases

7. Phase F: Migration Planning
   This phase describes the migration plan, how to move from the baseline to the architectural

8. Phase G: Implementation Governance
   This phase provides a broad overview of architecture with its implementation

9. Phase H: Architecture Change Management
   This phase provides a broad overview of architecture with its implementation

**Figure 1.** Phase in TOGAF.
10. Requirement Management
This phase provides an overview of the management of architecture as a whole ADM

2.3. ISO 27001
ISO 27001 is an international standard on information security by controlling policies, processes, procedures, organizational structures, and IT infrastructure [23] functions so as to reduce the risk of irresponsible parties [24, 25]. The control process at ISO 27001 refers to annex A which contains control over the information assets that must be maintained in Table 1.

| Risk Code | Risk Event                             | Ref. | Annex A                                      |
|-----------|----------------------------------------|------|----------------------------------------------|
| K101      | Staff Skills / Competencies            | A.7  | Human resource security                       |
| K102      | Operational support staff device       | A.12 | Operations security                           |
| K103      | Reverse engineering source code        | A.13 | Communications security                       |
| K104      | Bug fixing                             | A.14 | System acquisition, development, & maintenance |
| K105      | Internet Network                       | A.16 | Information security incident management      |
| K106      | Electricity                            | A.15 | Supplier relationships                        |
| K107      | Loss of Device / Asset                 | A.8  | Asset management                              |
| K108      | DDoS/Cyber Attack                      | A.10 | Cryptography                                  |
| K109      | Natural disasters                      | A.11 | Physical and environmental security            |

3. Results and Discussion
The enterprise architecture planned in this research is design of smart city architecture that has a high-security system in the tourism domain that includes smart experiences, smart destinations, and smart business ecosystems is with new technologies there are expected to be which able to cope the problem in the future, easily to implemented and maintenance. Resulting enterprise architecture design has gaps in Business Architecture, Data Architecture, Application Architecture, and Technology Architecture compared to the current general condition of technology and adapted to the organizational structure of the local government. Figure 2 is a comprehensive Enterprise Architecture:
Figure 2. Architecture Design of Smart Cities Tourism Domain.

Users (e.g. managers of tourism, tourists and other stakeholders) can access resources by using a network that is connected to cloud services. Cyber-physical systems (CPS), which are integrations of computation use Cloud services consist of software as a service, platform as a service and infrastructure as service. Cloud service will serve applications using microservices that communicate through Service-Oriented Architecture (SOA) [26]. Integrated applications and technology, supporting the activities of tourism and improving the business sector. The gap from Architecture design in Figure 2 is:

**Business Architecture**

a. The addition of new actors, that is Smart City Council which accommodates and takes a role in the development of smart cities.

b. The process of developing information technology that focuses on the utilization of data that has been collected, so that it requires new services from responsible actors, namely Banks and Telecommunications Operators.
Data Architecture
a. The addition of information subject areas and new data entities related to the coordinating business process by the Smart City Council and the process of data collection and analysis.
b. The addition of data relationships big data between information subject areas related to the addition of new actors, as a business of data collection that will be used in applications for smart tourism.

Application Architecture
a. Added five new applications, the Integrated Tourism Service Booking Application, GIS-based Tourism Activity monitoring Dashboard, the Tourism Industry Monitoring Application, the smart city portal and HR Management (e.g. tourist can be event search, map view, time filter, event lists, view event details so can quickly and easily identify the best locations and events, Job offers can be displayed on a map, filtered by location, skills or salary. Local people get a fast and flexible tool for dealing with job seekers and companies that employ real-time).
b. Eliminating functional applications that have been replaced by new applications, such as e-commando applications and information management and documentation applications.

Technology Architecture
a. The addition of new technology infrastructure to support applications and businesses, such as the addition of a data warehouse and analytics platform to support the process of collecting and processing data into information, decision support system, machine learning, and business intelligence in smart city ecosystems.
b. Replacement of technological infrastructure to more sophisticated systems, such as the replacement of standard EDCs to EDC that supports NFC, and replacing the cash register system for business entities into a Point of Sale (POS) system, which supports better business management.

Table 1 identifies information security risk controls that refer to Annex on ISO 27001: 2013, response controls that are designed to provide eligibility guarantees based on information security are explained in Table 2 with keywords referring to risk code.
Table 2. Control and Response.

| Risk Code | Control and Response                                                                 | Architecture          |
|-----------|--------------------------------------------------------------------------------------|-----------------------|
| KI01      | Application management staff from operators to administrators are encouraged and motivated to always improve their ability and awareness of the importance of information security. If necessary, through cooperation or training from third parties with control and supervision from superiors | Business Architecture |
| KI02      | Periodic maintenance and identification of device damage, determine the appropriate device requirements and procure new devices with control and supervision from superiors | Technology Architecture |
| KI03      | To improve and enhance the application of security systems in the source code, tighten the authentication of two-factor security system access to access the source code, conduct regular maintenance of the source code and the surrounding environment | Application Architecture |
| KI04      | Implement project management product development properly or if necessary, create new or change the old product framework | Business Architecture |
| KI05      | Using two telecommunications operators with one operator becoming a backup when the main operator experiences network problems and immediately reports to the manager of the main internet operator. | Technology Architecture |
| KI06      | Procurement of generators as backups when there is a power failure and immediately complain of disturbances to the National Electric Company (PLN), or conduct an inspection of the electricity network in the office by staff, carry out procedures to mitigate information security threats | Technology Architecture |
| KI07      | Improving the implementation of security systems in the work environment, running information back-up procedures related to data and information | Technology Architecture |
| KI08      | The staff responsible is trying to resist attacks, strengthen firewalls and install anti-DDos, perform necessary handling procedures and encrypt data | Application Architecture |
| KI09      | All office staff including superiors carry out disaster mitigation in accordance with their respective responsibilities, ending with a mitigation report to the city tourism office | Technology Architecture |

4. Conclusion
The Smart City Enterprise Architecture Design in the Tourism Domain has been produced along with gaps that appear using ADM 9.1 TOGAF. In the Architecture, there are the addition of Smart City Council actors for Business Architecture, integrated data and data warehouse for Data architecture, Command Application and GIS for tourists for Application Architecture, use of the latest technology such as NFC and IoT for Technology Architecture. In the requirements (Phase 10 TOGAF 9.1 ADM) in order to obtain high information security, controls and responses have been made based on the parameters of Annex A at ISO 27001: 2013.

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