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A Secure Multi-Layer e-Document Method for Improving e-Government Processes

Gia Nghia Vo
(La Trobe University, Melbourne, Australia
r.vo@latrobe.edu.au)

Richard Lai
(La Trobe University, Melbourne, Australia
lai@cs.latrobe.edu.au)

Abstract: In recent years, there has been a tremendous growth in e-Government services due to advances in Information Communication Technology and the number of citizens engaging in e-Government transactions. In government administration, it is very time consuming to process different types of documents and there are many data input problems. There is also a need to satisfy citizens' requests to retrieve government information and to link these requests to build an online document without asking the citizen to input the data more than once. To provide an e-Government service which is easy to access, fast and secure, the e-Document plays an important role in the management and interoperability of e-Government Systems. To meet these challenges, this paper presents a Secure Multilayer e-Application (SMeA) method for improving e-Government processes. This method involves five steps: namely (i) identifying an e-Template; (ii) building a SMeA; (iii) mapping the data; (iv) processing the e-Application; and (v) approving the e-Application. The first step involves requirements analysis and the last four involve data analysis for building a SMeA. To demonstrate its usefulness, we applied SMeA to a case study of an application for a licence to set up a new business in Vietnam.

Keywords: e-Government, e-Document, business process, security criterion expression, XML/XSD, service orientation, re-engineering, citizen-centric
Categories: H.3.3, H.3.5, H.4.3, J.1, E.m

1 Introduction

With the recent increase in innovative research topics on e-Government, e-Government is promising to achieve its goal of providing a better service to encourage citizens to use it more widely, especially in developing countries. However, to create a good e-service which is easy to access and offers faster and more secure processing, one of the main challenges is enhancing e-Government processes where e-Documents play as a central role in the integrated management and interoperability of e-System development. Researchers have recently become extremely interested in e-Document management to improve e-Government processes [Charalabidis and Askounis 2008]. Appling online for an official document is no longer an unusual thing. Thanks to the development of ICT, the effectiveness and utility of electronic systems is being used to build a better e-service for citizens. Korea is one of the best examples of a country which is making use of ICT to develop an e-Government system. With the highest level of online services and E-

participation, Korea was the number one in e-Government development in 2010, as ranked by the United Nations [Kim 2010]. As well, California, USA saved over 20 million USD by improving its e-Government system. Developing countries such as Vietnam, Malaysia and Bahrain are also on the way to building effective e-Government systems [Zukang 2010, Le 2010]. However, e-Government systems in developing countries face many concerning issues which need to be addressed. Heeks reported that in most government projects in developing countries, targets have not been set and many projects have been a partial or complete failure [Heeks 2003]. In administration in particular, it is very time consuming to process the different types of documents and there are many data input problems [Modinis 2007]. As well, with the idea of citizen-centric terms and process orientation, which is quite different to the previous research, the growing concerns recently are how to satisfy citizens' requests to retrieve government information and how to link these requests to build an online document without asking the citizen to input the data more than once or run around to submit their information in person.

In order to improve e-Government , there is a need for methodologies to enhance e-Government systems to meet the needs of citizens [Sanati and Lu 2008]. To provide an e-Government service which is easy to access, fast and secure, e-Document plays an important role in the management and interoperability of e-Government systems. To meet these challenges, this paper presents a Secure Multilayer e-Application (SMeA) method for improving e-Government processes. This method involves five steps: namely (i) identifying an e-Template; (ii) building a SMeA; (iii) mapping the data; (iv) processing the e-Application; and (v) approving the e-application. The first step involves requirements analysis and the last four involve data analysis for building a SMeA. To demonstrate its usefulness, we applied SMeA to a case study of an application for a licence to set up a new business in Vietnam.

2 Related Research work

A new vision for e-Government has been proposed in an effort to improve the quality and efficiency of online services to businesses and citizens. Recently, there have been many proposed e-service processes in the public sector with several models and methodologies suggested to improve public administration work [Becker, et al. 2006, Scheer and Nüttgens 2000]. We surveyed the scholarly work in the following four research areas: namely (i) re-engineering; (ii) information retrieval to improve requirements analysis, (iii) process improvement; and (iv) e-Document improvement. The survey results are listed in Table 1.

After reviewing the literature in this area, it is clear to see that the previous work has concentrated on general models or overall frameworks to reengineer the whole system but does not address, in detail, the design of the data framework nor does it show how to restructure e-Document data, increase e-Document data security and track the movement of the e-Document through the business process. For instance, in relation to their process orientation proposal to implement a procedural model to provide support for public administration, Becker et al. (2006) presented guidelines for designing a business process [Becker, et al. 2006]. However, these guidelines do not describe the full requirements of an e-Government system, rather, the authors only describe a case study. Amoretti (2007) suggested a reform-orientation for e-

Governments based on a top-down process linking the leadership and administration with legislative networks. Kunnis (2007) built a document management model based on a process folders hierarchy and a secure document level to access the e-Government system [Kunis 2007]. Recently, an e-Government case study was used to validate the feasibility of the Business Process Recovery (BPR) approach based on MARBLE (Modernization Approach for recovering Business Processes from the Legacy System). Perez-Castillo et al. (2011) presented four levels of abstraction combined with three transforming models, aiming to create a semi-automatic procedure for BPR [Pérez-Castillo, et al. 2011].

Methods	**Keywords**	**Comments**
Re-engineering *[Pérez-Castillo, et al. 2011], [Becker, et al. 2006, Scheer and Nüttgens 2000]*	Re-engineering, Transforming models, Architecture Driven Modernization (ADM), business knowledge to re-engineering, process orientation.	Four levels of abstraction combined with three transforming models. Embedding the business knowledge to reengineering work towards lower costs for maintenance and implementation
Information retrieval to improve requirements analysis *[Boubekeur, et al. 2010], [Zhang and Liu 2000], [Shehata, et al. 2006], [Setchi, et al. 2007], [Chiang, et al. 2011]*	Information retrieval, concept-based method and concept weighting, semantic text and terms associated with the documents, unstructured text, normalized term frequency.	Indexing e-Document using the WorldNet and the scheme for concept weighting. Aims to enhance the text retrieval performance concept-based method represented by an ontological graph based on analysing semantic text and the terms associated with their documents
Process improvement *[Becker, et al. 2006],[Kabilan, et al. 2005], [Amoretti 2007], [Kunis 2007],[Wasser and Maya 2013]*	BPMN, busines modelling, analysing a case study, multi tier e-document workflow patterns, process folders hierarchy, process orientation and knowlegde embedded in BP repository.	Business process design and guidelines, e-document workflow. Top-down process linking the leadership and administration. Process orientation for implementing a procedure model supporting public administration.
e-Document improvement *[Ghose, et al. 2007], [Greunz, et al. 2001], [Pan 2012], [El-Bendary, et al. 2011], [da-Cruz and Pedro 2011]*	Text-to-model and model-to-model, e-Signature, secure XML, secure criterion expression, e-Document container, exproring documents annotated with XML.	Document management model based on a secure document level. Business knowledge from text-based approach through activity documentation. Online security for e-Document Digital signature approach for e-Contract

Table 1: The scholarly work conducted in four research areas

To transfer business knowledge from a text-based approach to activity documentation, Ghose et al. (2007) proposed a framework and prototype tool for

Rapid Business Process Discovery in which they defined two models for technical extraction: text-to-model and model-to-model [Ghose, et al. 2007].

e-Government offers citizens a non-profit service so the stakeholders do not negotiate an agreed contract where profits and benefits are the main goals. In the case of an e-Licence, the main step in the process is the government agencies' evaluation of the e-Applications submitted by the citizens, based on the terms and conditions.

Thus, when citizens increase their use of e-Document technology, in order to develop an effective and secure e-document, there is a need to continually improve the e-Document processes as well as ensure efficient data integration.

3 Goal modelling concepts

A goal is a key target for the development strategy of an organization. It includes sub-goals, tasks and resources to improve business processes [Fox, et al. 1996, Barlas and H. 2006]. To support the organizational goal, Fox et al. (1998) extended the goal concept by integrating it with the various elements of an organization, such as goal, agent, task, role, division, team, communication, authority and commitment. Also, they developed a diagram showing the links between the elements to perform status changing actions [Fox, et al. 1998]. This work is shown in Figure 1.

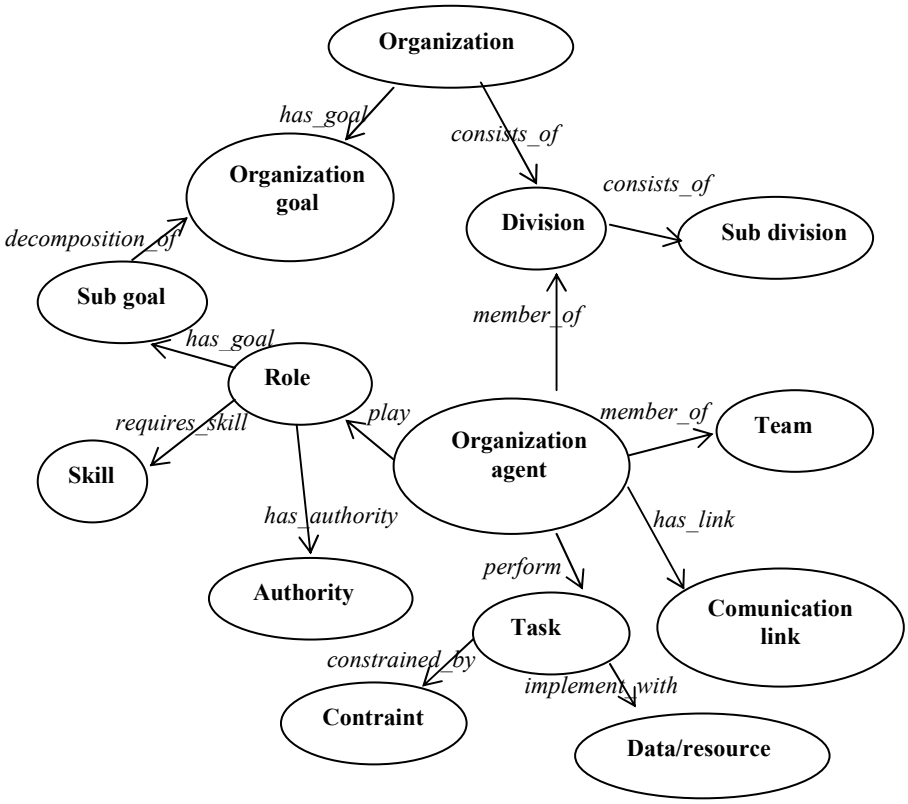


Figure 1: Organizational Goal and its linking concepts

In order to achieve the goal of e-Government, an SMeA is designed to improve the interaction between the data/resource and tasks to update the stakeholders' data. Moreover, the SMeA processes also describe movement statuses through the business processes in which the tasks and the data play a central role in changing the e-Application.

3.1 e-Application (eApp) definitions

e-Application (eAPP) is a tube of data recording the interaction among stakeholders on an e-Template (eTem). Based on the data in the e-Application submitted by the citizen, the e-Government system will generate either an approved or rejected the application.

e-Template (eTem) is an administrative procedural template created by the Government. It contains layers including user manuals, the format of stakeholders' data and rules and conditions. It also defines security rules and criteria expressions for agencies involved in future e-Applications.

a-Template (aTem) is an combination of e-Template and citizen data sent to the e-Government system.

e-Application database (eADB) and *e-Template database* (*eTDB)* is a collection of e-Applications and e-Templates respectively. The eTDB and eADB will be the base information for data retrieval and the management of the e-Government system.

Figure 2 shows an e-Template (eTem) which is an administrative procedural template created by the Government (without data on the citizen and the agencies). The citizen and the agencies use this template to add their data to build an e-Application. Thus, an e-Application is the combination of the eTem, citizen data and agencies'data.

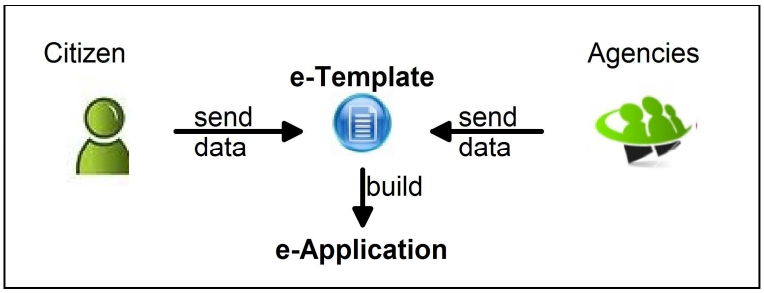


Figure 2: e-Application

4 The Secure Multi-layer e-Application Method

In the early 1990s, Hammer and Champy (1993) defined a process as activities which must be performed on input products to create output products that will add real value for the customer [Hammer and Champy 1993]. As well, government departments which were organized in a traditional way implemented a functional view of

separated departments, such as administration, service, planning, and finance, which resulted in an increased workload for the administration department in terms of processing everyday tasks through the functional departments. Thus, using the business process orientation view instead of the functional view, the divisions between departments are broken down enabling government agencies to focus more on their activities to meet the goal of creating better value for citizens.

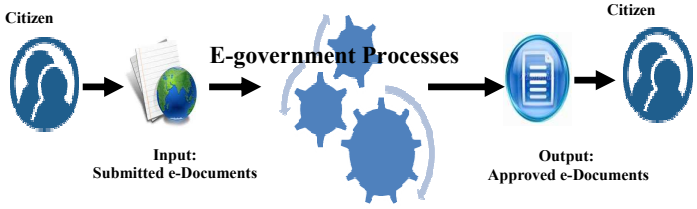


Figure 3: e-Government processes

By using the business process orientation view, the citizen becomes the centre of the process which will result in faster and more accessible services and will hence satisfy their requirements [Scheer 2000]. Thus, to enhance e-document processes, an SMeA method is proposed and summarized in the process steps shown in Figure 4. The proposed method involves five steps based on two different types of analysis, requirements analysis and data analysis. Step 1 involves applying an information retrieval (IR) method to match a citizen's request based on the e-Templates in order to make it easy to retrieve and send the information needed by the citizen. Steps 2 and 3 involve mapping an e-Template from the retrieved result to build a SMeA. This work re-uses the data passing between various agencies for a faster transferral process in the e-Government system. The mapping to form the business process is based on XML data integration, Security Criterion Expression (SCE) and BPMN 2.0 to describe e-Document movement. To process the e-Application, steps 4 and 5 detail the tasks which are undertaken by the various agencies to assess the e-Application. This involves the combination of an e-Signature and an XML SCE for a safer transferal process in the e-Government system. The authentication of the SMeA is based on three steps of security, namely mapping, signing and verifying. The resulting SMeA process can be used to facilitate an integrated flow of exchanged information between government agencies. It also has a control logic to support the reuse of data and assists citizens to track their online applications more easily. This will enhance the administration of the e-Government process, especially in relation to e-Document management and the administrative application process.

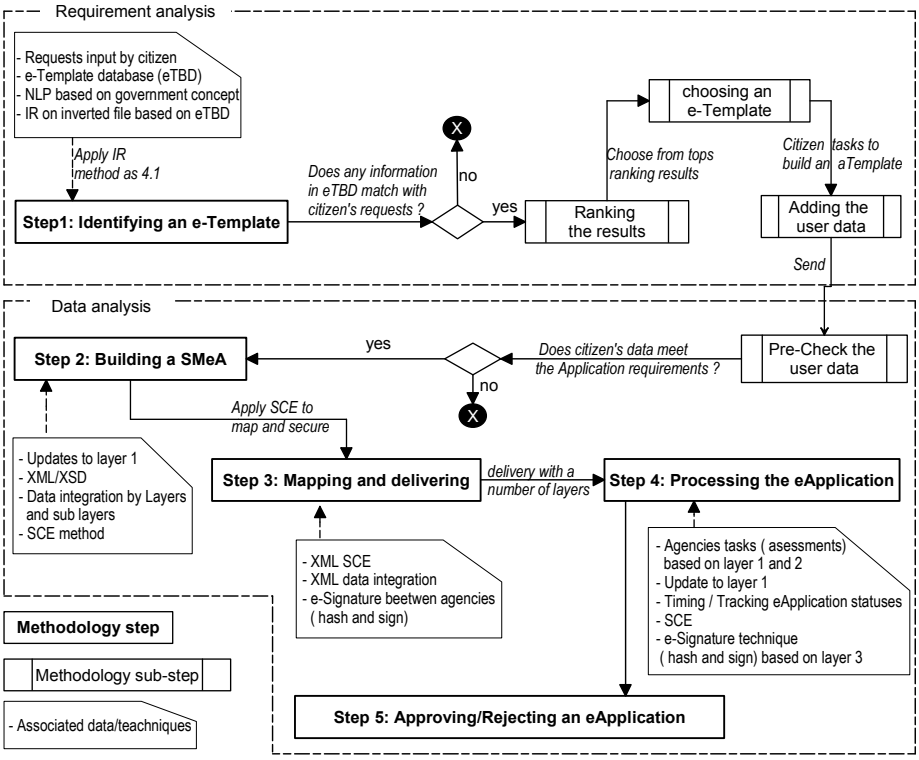


Figure 4: SMeA method for e-Government processes

4.1 Step 1 - Identifying an e-Template

A citizen sends the request to the online system to find a particular e-Template. The e-System will assist them to identify the information and decide which particular e-Templates need to be completed and apply.

To analyse the citizen's request, the system uses Natural Language Processing (NLP) to analyse and enrich the requests. This task aims to match everyday language to the formal language which is used in the government's e-Documents. Then, the system will automatically build queries and execute them based on the enriched requests. If a match is found, the ranked results which are the best match for the citizen's request will be shown. Otherwise, a 'request not found' message will be sent.

The details of the NLP method, including concept indexing and the data integration approach in this figure were given in [Vo and Lai 2014]. In this paper, we presented the use of the information retrieval method and the government concept to match from everyday language to formal language which is used in the government's e-Documents [Vo and Lai 2014].

Figure 5 shows the steps using the IR to match the citizen's requests to the e-Government system.

The e-Template inverted index file was built before executing step 1	
- *Create or update the Multi-layer e-Template data collected from the old paper/electronic procedure.* - *Extract the 1st layer (or description layer) of the multi-layer e-Template to create the file inverted index (Fii).*	Coding: - *Create the eTem with $tTem_j$ layer* - *Update to $eTem_i$ database* - *For i=1 to n* *If executedfile ($eTem_i$)= false* *begin* *extract $tTem_1$ → $eTem_i$* *adding → Fii* *end*
Sub-steps to execute Step 1	
- *Get the citizen's request* - *Use Natural Language Processing to analyse the request* - *Enrich the request using eGov concept* - *Build and execute the query to file inverted index (Fii)* - *Rank the results which are best matched with the citizen's request.*	Coding: - *Get citizen's request (Cr_i)* - *NLP(Cr_i)* - *Enrich with the eGov concept $RCr_i=Cr_i+Enrich(Cr_i)$* - *Query (RCr_i) → Fii* - *Return results list $RL(RCr_i)$* - *Rank(RL)*

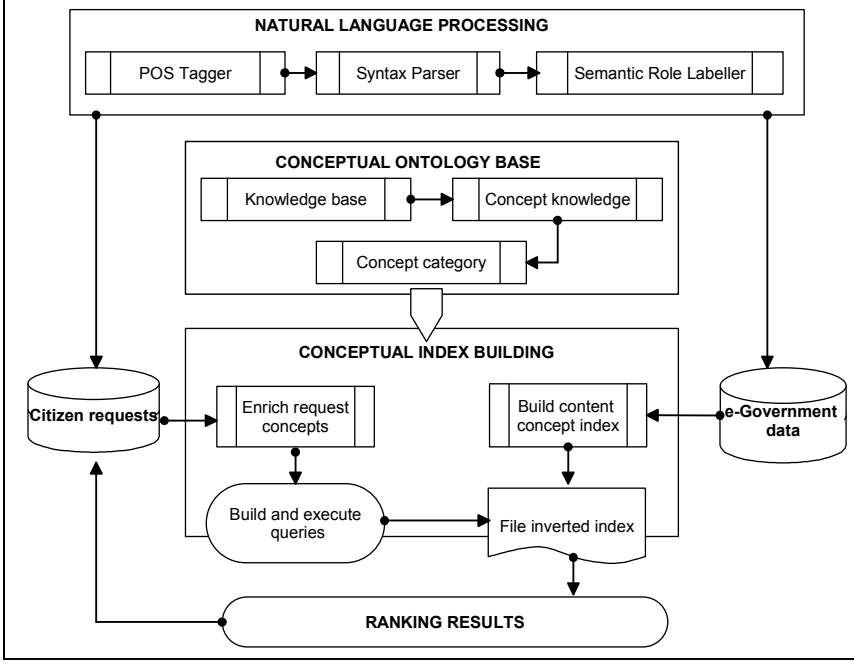


Figure 5: Mapping the citizen's request to choose an e-Template

4.2 Step 2 - Building an SMeA

e-Documents are one of the core elements of the e-Government ontology. Almost all

e-Government activities focus on the provision of better services in which e-Documents play a role as input and output products [Charalabidis and Askounis 2008, Klischewski 2006]. Once the citizen has identified the specific e-Template, they then enter their data to complete the e-Template requirements. This is the major input data step for future assessment by the government. This leads to metadata identification and changes the status of the e-Template to an active e-Template (aTemplate). The SMeA can be summarized by the framework shown in Figure 6.

<table>
<tr><td rowspan="2">Data Layer</td><td colspan="2">Terms and conditions</td></tr>
<tr><td>Citizen data</td><td>Government data</td></tr>
<tr><td>Control Layer</td><td colspan="2">Data integration in XML, Timing, Tracking Update data, mapping to XML</td></tr>
<tr><td rowspan="2">Security layer</td><td colspan="2">Security criterion expression approach, eSignature</td></tr>
<tr><td colspan="2">mapping → signing → verification</td></tr>
</table>

Figure 6: SMeA

SMeA consists of three layers: namely, the data layer, the control layer and the security layer. The first layer, the data layer, stores the data of parties involved in the e-Application, for example, the citizen's data, the government's terms and conditions, and the agencies' assessment of the data. We use a data-centric approach to divide the data structure into layers and sub-layers. It is easy to map a limited number of data sets to XML data files which are passed between different government agencies. The second layer, the control layer, is executed by events to control the interactions between the citizen and the government. It uses timing methods, e-document tracking, auto-generating the involved agencies, updating the citizen's data and assessing the agency data. The third layer, the security layer, is designed to resolve potential security problems. We propose the use of (1) XML security criterion expression to determine permissions to access the data layer; (2) the e-Signature method, including mapping, signing and verification to ensure security between parties such as C2G, B2G or G2G during the exchange of e-Documents.

The data layer (D) contains the citizens' and the government's data and the terms and conditions of the e-Application.

- The terms and conditions are the regulations of the e-Application. The citizen has to follow these regulations to apply for an e-Licence.
- Citizen data (cD) is the information required by the e-Application which is assessed by the agencies.
- Agency data (aD) normally is the assessment information. This data is used to generate the results of the e-Application in order to issue a licence.

Thus, the data layer (cD, aD) includes sub-layers cD_i, aD_i defined by the e-Application template.

The data layer is handled by the data monitoring module. This manages and verifies the parties for data updates. If the updates are approved, the data will be updated on the e-Application data layer.

4.3 Step 3 - Mapping and delivery

Depending on the type of aTemplate, the inter-relationships and conditions, the number of layers in the e-Application are sent to relevant government agencies for further assessment. From the authorization rules, developing a methodology has been transformed into security criterion expressions and security criterion subsets. This is more flexible in protecting data. Pan [Pan 2012] developed a method to embed the security expression to XML files, based on XML schema which has well defined security criteria. Thus, in the security layer, the security criterion expressions will be mapped from the authorization rules. This will ensure that portions of XML file are generated to the specified agencies and it can be accessed by them. The SCE will be defined for each e-Template to narrow the data which can be accessed as well as the data size in the transaction.

For example:

- S_0: Register /unregister user; and - S_1: Access (T/F)

The security criteria for the data (D) and task (T)

- $S_i(cD_i)$: security criteria to be set for citizen data
- $S_i(aD_i)$: security criteria to be set for agency data
- $S_i(cT_i)$: security criteria to be set for citizen tasks
- $S_i(aT_i)$: security criteria to be set for agency tasks

The authorization rules are combinations of security criteria. This is declared in the XML schema and mapped automatically to the XML file based on logical expressions and security rules.

4.4 Step 5 -Processing the SMeA

After identifying the conditions, the related attached documents and the binding relationships among the identified obligations, rules and rights, the agencies will process the e-Application.

In this step, we describe the control tasks including data execution and updating; timing and tracking. Thus, this step will interact with layer 2 to generate events to execute the stakeholder's tasks. The results will be updated to the data layer.

Tasks are the activities performed on the data needed to build the e-Application. Figure 7 shows the task of parties to verify and update data. Thus, the status of the task changes when there are updates, including the following actions: processing (sPr), pending (sPe), suspend (sSu) and complete (sCo).

- Citizen task (cT) is activities related to cD on eTem such as input or update the cD.
- Agency task (aT) is the assessment activities of the agencies on cD to create aD.
- e-Application (eApp) is the combination of the e-Application template (eTem) with user data and agency data.

$$eApp = cT(eTem(cD)) + aT(eTem(aD))$$

In detail: $eApp = cT(\sum_{i=1}^{n} eTem(cD_i)) + aT(\sum_{i=1}^{n} eTem(aD_i))$

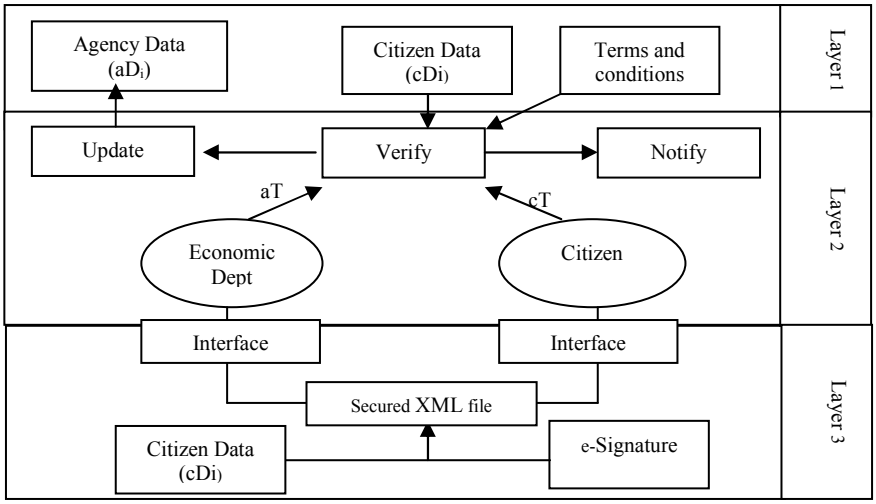


Figure 7: Tasks of data verification and updates

Timing: the concepts of time points and relative time are applied in this framework to evaluate the agency tasks involved in the SMeA. We define the evaluation time (T): $T_{taski}=T(aT_i, D_b, D_d, D_c)$ where the time points D_b and D_c correspond to the beginning task and completion task. D_d is the relative time for the distance between two time points D_b and D_c. The evaluation time is set with two statuses: (1) Duty (Dt): the total time duration that an agency has to finish the task; and (2) Out of date (Od): the total time duration that an agency takes to process the task has exceeded the Dt.

Thus, based on the time evaluation, the statuses will be assigned as either processing (sPr), pending (sPe), suspend (sSu) or complete (sCo).

Tracking: the tracking system is used to capture any changes to movements of an e-Application. Any change in an e-Application will be recorded to authorize the personnel who can access it. Thus, the citizen/business can check their application by status or history tracks. An e-Application can show as being *in process, pending, complete or suspend* if it is tracked by status. All revisions or approval history records of e-Application also are reviewed by accessing the history tracking feature.

Security plays an important role in implementing the e-System. As suggested by Gauravaram and Foo (2007), there are seven goals to be achieved to ensure the safety of an eContract: confidentiality, integrity, authenticity, non-repudiation, availability, proof of agreement and proof of existence [Gauravaram and Foo 2007]. Thus, in the e-Government, to ensure that the security goals are met for the e-Document in the system, the SMeA designed has to meet the security goals.

In this step, the security process applied to SMeA will be run in three sub-steps: (1) based on the SCE, the limited data layers will be mapped to the XML file with limited access control conditions; (2) this file will be hashed with a hash function and will return a hash value to ensure the original content is not modified. An e-Document which has been signed by the e-Signature authenticates that the original document has

not been changed; (3) when the receiver obtains the e-Document, they verify it. If they match, the e-Document and e-Signature are accepted. Otherwise, they will be rejected.

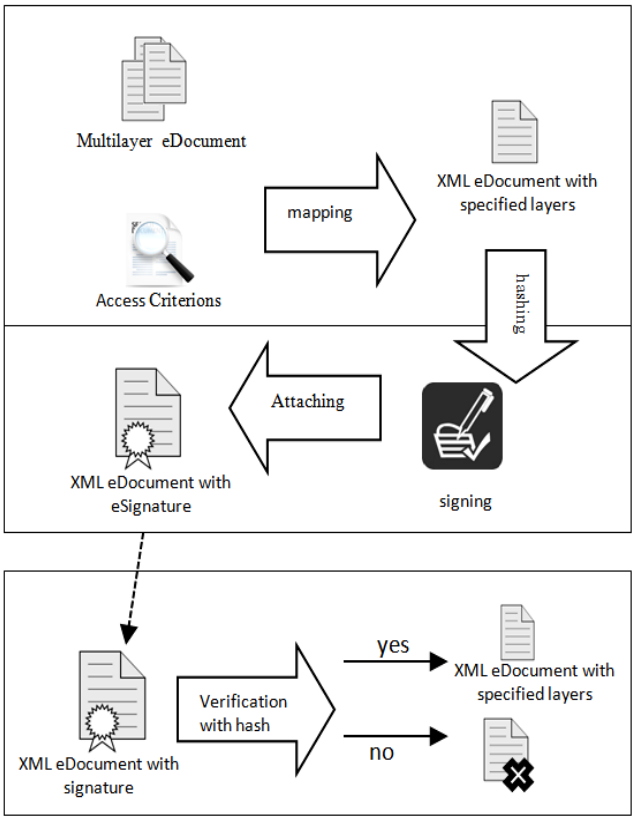


Figure 8: the security process applied to SMeA

4.5 Step 5 - Approving an e-Application

A decision on an e-Application can be of three types: (1) approved; (2)to be re-submitted; and (3) rejected. These are explained as follows:

- Approved – For an e-Application to be given the "Approved" status, it has to satisfy every agency's requirements.
- To be resubmitted - If an applicant fails to supply the information required or certain information supplied needs further clarification, the e-Application will be sent back to the citizen for revision for re-submission.
- Rejected – This means that the e-Application did not meet one or more of the requirements or rules of one or more of the agencies. The guidelines will be sent to the applicant so that they knows why their application was rejected.

5 A Case Study

A citizen applying for an e-Licence to set up a business with the Vietnamese Government.

- Job description: applying for an e-Licence to set up a new business
- e-Templates: Registration Form (e-Template layer code: DKKD-I-6); Tax Registration Form (e-Template layer code: 03-DK-TCT)
- Agencies: Economic Department, the local council, Tax Department, Administration Department.
- Input: e-Document based on e-Template.
- Output: Licence to run a private business and Tax File Number (TFN).
- Time duration: 7 working days.

Parties	**Task descriptions**
Citizen	Submit the forms including personal data, business data: tax, financial reports, business location, for a license to set up a new business
Information Center (A1)	Pre-check e-Documents supplied by citizen Build the e-Application Send and receipt the assessment results
Economic Department (A2)	Assess the business information in the e-Application based on the citizen's data, local council data and tax department data. Issue the business licence
Local Council (A3)	Check the business location and personal information
Tax Department (A4)	Check the tax information and issue the TFN

Table 2: Task description of parties involving in the case study.

6 Applying the SMeA Method

6.1 Step 1

The citizen sends the request to the online system to find an application for a license to set up a new private business company. The system will guide the citizen to the main information requirements.

For example, a citizen sends a request Cr_1 to the e-Government system to apply for a licence to set up a private business. Cr_1="I want to apply to set up a new private company". The eGov system will use the IR module to analyse the request Cr_1 as shown in Figure 5. Thus, we have the result as follows:

- Natural language processing NLP(Cr_1)="apply/VP new/A private/A company/NP"
- To enrich the request, Government concepts are added to Cr_1 (raw_word/government_concept) RCr_1=Enrich(NLP(Cr_1))="apply/c214 new/c342 private/c145 company/c182" and the system uses RCr_1 to build the query to the eTBD.

- A ranked list of the best matches for the citizen's requests is shown for the citizen to choose one. In this case, they will choose a business licence e-Template code: NPBC-TCT-3-6 which has two parts, namely Business Registration (e-Template layer code: DKKD-I-6); Tax registration (e-Template layer code: 03-DK-TCT).
- Once the citizen identifies the specific e-Template - NPBC-TCT-3-6, they enter the citizen data (cD) to complete the e-Template requirements as shown in the task descriptions in Table 2. This changes the status of the e-Template to an active e-Template (aTemplate) and this is then sent to the system for assessment.
- The citizen submits the forms including (cD_1), (cD_2), (cD_3), (cD_4).

cD1 : Personal data
cD_2 : Business information declaration
cD3 : Financial data
cD4 : Tax report data

aD_1 : Assessment data of the local council
aD_2 : Assessment data of the Economic Department
aD_3 : Assessment data of the Tax Department

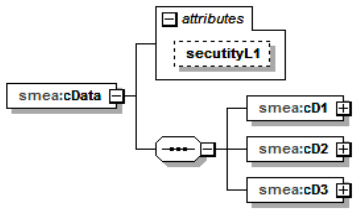
6.2 Step 2

The administrators pre-check the aTemplate. If it meets the e-Template requirements, then the current aTemplate will be mapped to build the SMeA. Thus, Layer1 of the SMeA will be updated by cT to fulfill the terms and conditions in the eTem: NPBC-TCT-3-6.

XML schema

element **seapp/L1/cData**

diagram



namespace: http://skncnbinhdinh.gov.vn/smeaProject/

properties: content **complex**

children: **smea:cD1 smea:cD2 smea:cD3**

attributes

Name	Type	Use	Default	Fixed	Annotation
secutityL1	xs:string			s1	

source

```
<xs:element name="cData">
 <xs:complexType>
  <xs:sequence>
   <xs:element name="cD1">
    <xs:complexType>
     <xs:sequence>
      <xs:element name="cIdentification" type="xs:strin
      <xs:element name="cLName" type="xs:string"/>
      <xs:element name="cFName" type="xs:string"/>
      <xs:element name="cAddress" type="xs:string"/>
      <xs:element name="cTel" type="xs:string"/>
      <xs:element name="cEmail" type="xs:string"/>
```

Citizen XML data file

```
<?xml version="1.0" encoding="UTF-8"?>
<smea:seapp
xsi:schemaLocation="http://skncnbinhdinh.g
ov.vn/smeaProject/ smeappf.xsd"
xmlns:smea="http://skncnbinhdinh.gov.vn/s
meaProject/"
xmlns:xsi="http://www.w3.org/2001/XMLSch
ema-instance">
<smea:L1>
<smea:cData secutityL1="s1">
<smea:cD1>
        <smea:cIdentification>211602010
</smea:cIdentification>
<smea:cLName>Vo</smea:cLName>
<smea:cFName>Ryan</smea:cFName>
<smea:cAddress>260 Oriel RD, Heidelberg
West, Victoria, Australia </smea:cAddress>
<smea:cTel>0433611888</smea:cTel>
<smea:cEmail>
r.vo@latrobe.edu.au</smea:cEmail>
</smea:cD1>
<smea:cD2>
<smea:cBName>RyanVNAUS company
</smea:cBName>
<smea:cBAddress>14 Ngo Quyen, Quy
Nhon, BinhDinh,
Vietnam</smea:cBAddress>
<smea:cBPhone>+84563823287</smea:cB
Phone>
</smea:cD2>
<smea:cD3>
<smea:cFinance>freport2012_010.pdf</sm
ea:cFinance>
```

Figure 9: the XML schema and XML file of SMeA

6.3 Step 3

In relation to the e-Template - NPBC-TCT-3-6, the number of layers in the e-Application are sent to relevant government agencies for further assessment. There are four agencies involved in assessment of the business licence: the Information Center, the Economic Department, the Local Council and the Tax Department.

From the authorization rules, the security criterion expressions will be mapped from the authorization rules. This will ensure that portions of XML are generated to the specified agencies and can be accessed by them. The SCE will be defined for each e-Template to narrow the data which can be accessed as well as the data size in the transaction. The authorization rules are combinations of security criteria. This is declared in the XML schema and mapped automatically to the XML file based on logical expressions and security rules.

Security criterion expression will apply for each agency

- Local Council: S1^T7^T12
- Tax Department: S1^T4^T4.1
- Economic Department: S1^T2^ T3^ T5^ T6

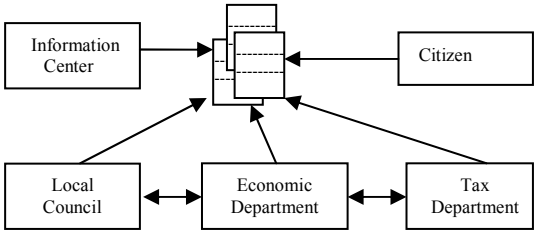


Figure 10: Parties involed in the SMeA

6.4 Step 4

After identifying the conditions, the related attached documents and the binding relationships among the identified obligations, rules and rights, the agencies will process the e-Application.

Parties	**Tasks description**	**Tasks**
Information Center (A1)	Pre-check e-Documents supplied by the citizen and build the e-Application. Send and receipt the assessment results.	T1 T10.1, T10.2
Economic Department (A2)	Assess the e-Application on the business information based on the citizen's data, local council data and Tax Department. Issue the business licence.	T2,T3,T5, T6 T10
Local Council (A3)	Check the business location and personal information.	T7, T12
Tax Department (A4)	Check on Tax information and providing TFN.	T4,T4.1

Table 3: Task description of parties

For every task of each agency, the time duration will be set as following:

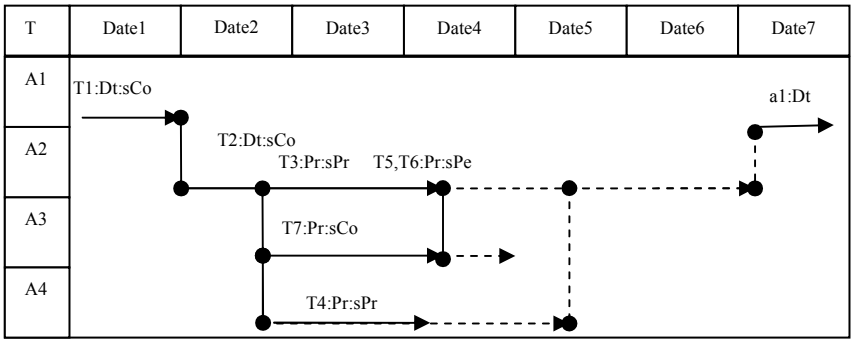


Figure 11: Timing tracking for the agency tasks

In the case study, the time duration of the whole process is seven working days. But there will be different time durations for the tasks performed by each agency. For instance, the time duration of T_4 is three days and the time line of A4 can show T4:Pr:sPr. This means that the Tax Department implements task 4 with time duration of 3 days. At this time, T_4 is executed in 2 days and is in the process status.

Task	**Description**
aT_1	Pre-check the cD and build eApp
aT_2	Check eApp and forward to related agencies for assessment
aT_3	Check business information
aT_4	Check tax information
aT_5	Make the final decision on the e-Application based on the assessments from all the agencies.
aT_6	Issue business licence
aT_7	Check application business location

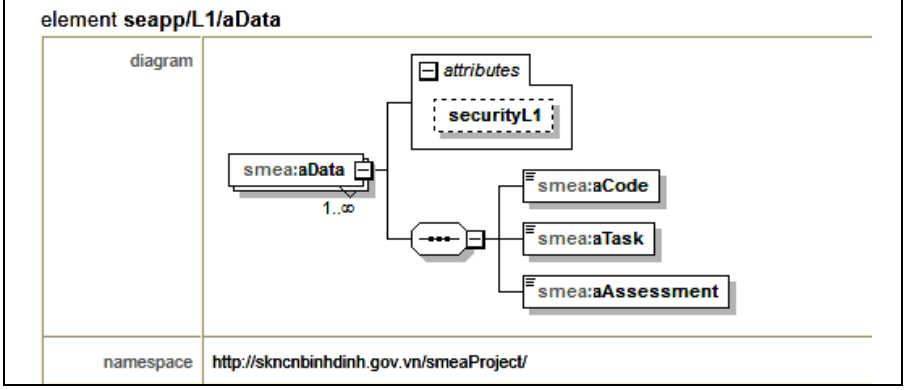


Figure 12: Task schema and task definitions of agencies involved in the SMeA

Based on the security layer, the secure criterion expressions and the e-signature method will be applied to the SMeA and the data from the Multilayer e-Application database will be mapped to an XML e-Document. This file will be hashed and signed for security purposes.

To exchange data between the Economic Department and the local council, XML file (ED2LC_ce1.xml) is created with 2 sub-layers for the business information including business location information; and personal information. This file will be hashed with value h and secure by (r, s) as the eSignature of the system generated to meet the original XML document.

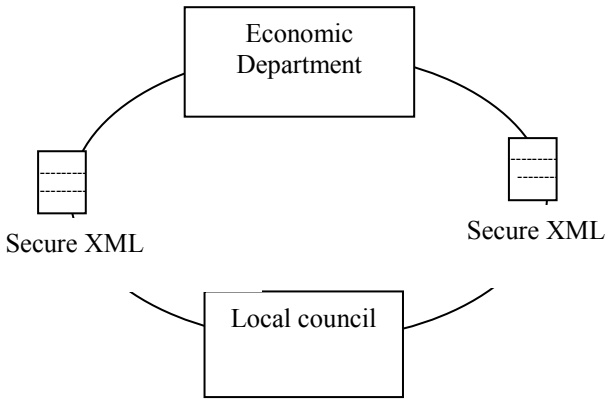


Figure 13: Exchange the secure XML document between parties

6.4.1 Security experiment on data exchange between agencies

For example, to exchange the sample cD data shown in step 2 between the local council and the Economic department, the system will process the task of the Economic department as follows:

- Hash the file ED2LC_ce1.xml with the hash function H(D) to obtain the digest value h:

  h= GS9BGKs2OG4BGNwgFQz75hchb8WfQhdE1M1Ex/xEBzI=
- Use the FconvertInt function to convert h:

  FconvertInt(h) =3534
- Apply the ElGamal signature method to create the e-Signature

  (r,s)=(20,4)
- Send the file with the attched e-signature as shown in Figure 14.

The local council verifies the e-Document by using the hash value and e-Signature attached to the e-Document. After recalculating the hash value, the local council compares the hash value with the hash value of the sender's e-Document and verifies the e-Signature. If they match, the e-Document and e-Signature are accepted. Otherwise, they will be rejected.

The ElGamal signature method is depicted as follows:

A large prime number p is generated
g is a large prime number's factor generated by Z^*_p *and gcd(g,p)=1*
x is a random number where $x \in (1, p-1)$
Calculate y where public key is (y, x , p) and private key is x.

$$y=g^x \bmod p$$

Thus, when sender signs the document D they will:

- *Select a random number k where* $k \in (1, p-1)$ *and gcd(k, p-1)=1*
- *Calculate* $r=g^k \bmod p$
- *Calculate* $s =(FconvertInt(H(D)) - xr)k^{-1} \bmod (p-1)$

H is the hash function and FconvertInt is a function converting the digest value to integer. Then, when attach (r, s) as the sender's e-Signature to the original XML document D.

Verification method:

The receiver verifies document (D)
If eSignature (r, s) matches the equation: $g^{h(D)} \bmod p = r^s y^r \pmod p$
then
accept eSignature
else
reject eSignature

```
<?xml version="1.0" encoding="UTF-8"?>
<xsig:Signature xmlns:xsig="http://www.w3.org/2000/09/xmldsig#">
    <xsig:SignedInfo>
        <xsig:CanonicalizationMethod Algorithm="http://www.w3.org/TR/2001/REC-
xml-c14n-20010315"/>
        <xsig:SignatureMethod Algorithm="http://localhost/smea/TestElGamal#Sig "/>
        <xsig:Reference URI="cDatac010.xml">
        <xsig:DigestMethod Algorithm="http://www.w3.org/2001/04/xmlenc#sha256"/>
        <xsig:DigestValue>
GS9BGKs2OG4BGNwgFQz75hchb8WfQhdE1M1Ex/xEBzI=
        </xsig:DigestValue>
        </xsig:Reference>
    </xsig:SignedInfo>
    <xsig:SignatureName>RyanVo</xsig:SignatureName>
    <xsig:SignatureValue>29,8</xsig:SignatureValue>
</xsig:Signature>
```

Figure 14: E-signature with the digest value

6.5 Step 5

The Economic Department will be the final review agency and based on all the agencies' assessments, the e-Application will either be approved or rejected.

The BPMN 2.0 is used to describe the case study using the SMeA method.

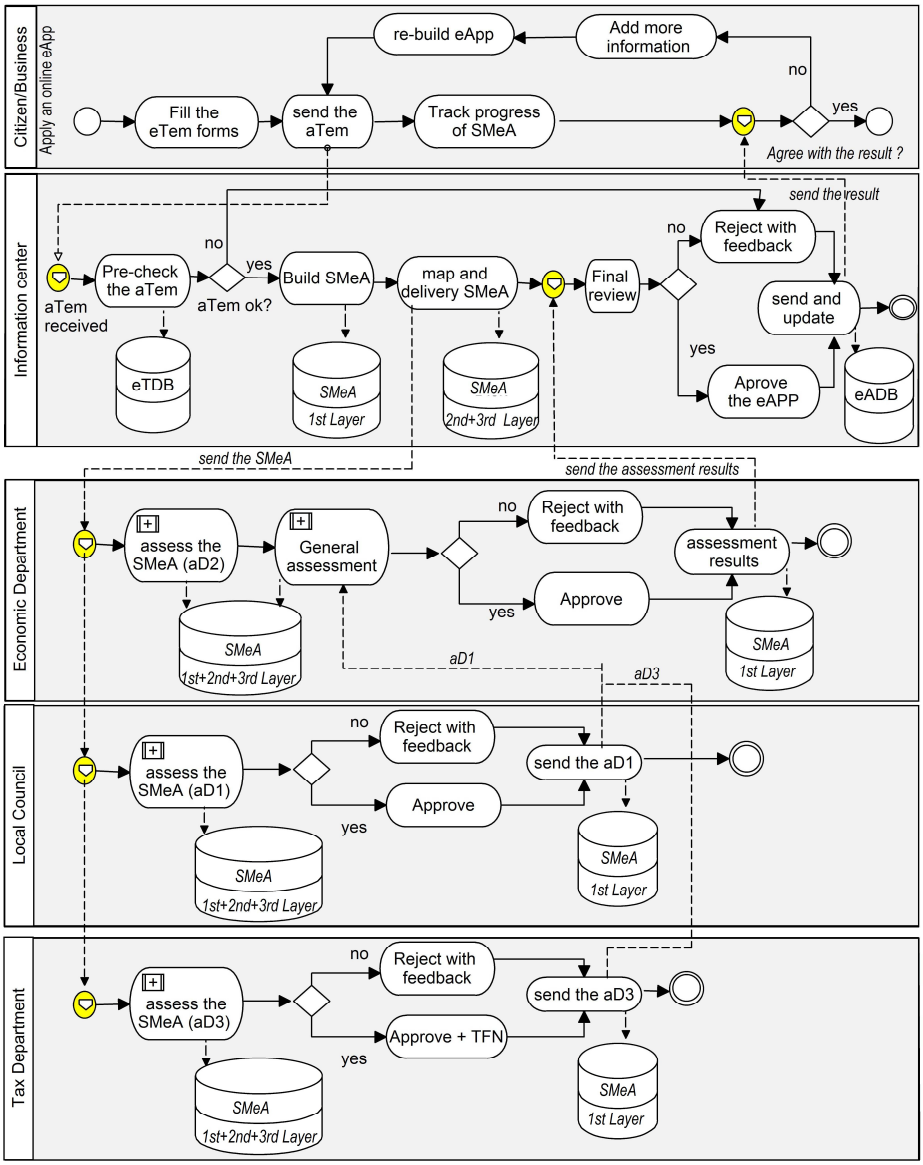


Figure 15: Building business processes for applying for an e-Application

7 Conclusion

In this paper, we have described the SMeA method to enhance the e-Document process for the e-Government system. This method aims to support the auto delivery and re-use of data passing among agencies for faster transferal in the e-Government

system. For data integration, we proposed a method for the data structure using layers and sub-layers. XML/XML schema was the technique used to define the data structure. To protect the e-Document in terms of data integrity, non-repudiation and originator authentication, we proposed the combined use of an e-Signature and a SCE approach. Also, by using the organizational goal ontology as well as the information retrieval approach, the methodology in mapping the citizen's requests to build a multilayer e-Application has been described in detail. This work also presented the mapping technique on the business process based on BPMN 2.0 to describe the movement of the e-Application. The resulting e-Document process can be used to facilitate an integrated flow of exchanged information among the various government agencies. Finally, by using a case study on applying for a licence to set up a business in Vietnam, this paper illustrated how the process improved the flow of the administrative work, especially in relation to electronic document system management and helps the citizen to more easily track their online application.

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