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Algorithms to analyze the impact of change on Enterprise Architecture

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Abstract

Currently, the organizations are constantly confronted with rapid and radical changes, making the company in turbulence that requires a transformation from a state to a target state. This turbulence needs agility on the part of companies, i.e. the ability to monitor their environment and be ready to react. Enterprise architecture needs transformation if its levels of abstraction are affected by its changes, so enterprise architecture needs to be agile to evolve over time. To measure the impact of change on the abstraction levels. This article proposes different algorithms to proceed to the change impact analysis in the different abstraction levels to be able to analyze the change impact of different projects on the elements of the enterprise architecture and to make it agile.

Keywords: Change ; Enterprise Architecture ; Algorithms ; impact analyze.

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1. Introduction

Today, companies are confronted with rapid changes in the business environment, making business agility a crucial step towards achieving competitive advantages over the competition. Nowadays, instability makes this quality necessary and even indispensable. This is how today's organizations are faced with executing and changing current strategy to survive today's challenges while being fluid enough to adapt to tomorrow turbulence. The implementation of changes must obviously be adapted, in most cases; these changes have a relative effect overall organization including the organizational elements of business and information technology, so if the strategy or structure of the company changes accordingly to make it agile, will the other elements be modified in a synchronized way?

Previously, in our previous research [1], we studied different agility metrics in all the domains, and we concretized specific metrics for each level of abstraction. To validate these metrics, we developed a CBITA approach [2] that manages the comparison of several projects by studying the existing AS IS and the TO BE target in order to identify the changes acquired during this transformation. The evaluation of this approach will be done by specific algorithms based on the metrics that we have completed in the analysis of agility metrics on the levels of Architecture Enterprise.

The projection on the level allows an external analysis to observe the relationship with the environment but also the internal observation of the correlation between these measures.

For this, algorithms will be realized to demonstrate the analysis of the impact of the change on the different layers of the enterprise and more precisely the abstraction levels of the enterprise architecture:

- Algorithm that loads relationships and components from CSV files exported from the Archi modeling tool and visualizes them,
- Algorithm that performs a comparison between the metadata of the two CSV files (AS IS and TO BE):
    - By calculating how much change has been made between the two files,
    - Calculating the number of element entities between the two files,
    - By analyzing the impact of the change on the element that was affected, displaying it and examining whether it was modified, deleted or added as a new element.
- Algorithm for creating graphs to visualize the impact analysis

This document will be the validation of our previous studies of a change impact analysis approach by a CBITA approach which is concretized in 3 steps, summarizing them by (1) Study of the existing "AS-IS" (2) Modeling of the IT project and finally (3) Analysis of the changes of the target architecture TO BE. This approach will be evaluated to analyze the change of impact of projects on an enterprise architecture by taking into consideration the AS IS and TO BE and by analyzing the elements that will be impacted by the projects to be able to make an enterprise architecture agile

The paper is structured as follows: Section 2 presents the CBITA approach; Section 3 presents the different algorithms for change impact analysis with respect to the CBITA approach. Section 4 presents the discussion and conclusion of this study, and gives directions for future work.

2. Related work

2.1. CBITA Approach

Today's companies must be able to maintain their evolution, they must be able to execute and change the current strategy to survive today's challenges while being flexible enough to adapt to tomorrow's turbulence. Organizations must be agile to respond quickly to change, as each organization has a different strategy, the implementation of change must obviously be tailored to all elements of the organization, from business to information system, in order to maintain and manage an aligned system. You need an effective system that manages the business strategy, processes and information systems while capturing change to make the system agile.

As research has advanced, business IT alignment has become a priority for many researchers, including modeling and building business IT alignment between different abstraction levels of an enterprise architecture (EA) [3]–[5] business IT alignment assessment to measure the level of alignment between abstraction levels [6]. With the

exception of change, detection to achieve the agility factor in the system is clearly not defined in the different studies found, and it is rarely considered as a concept in itself [7].Therefore, it is rarely represented and therefore difficult to reason about a concept if it is not clearly formalized.

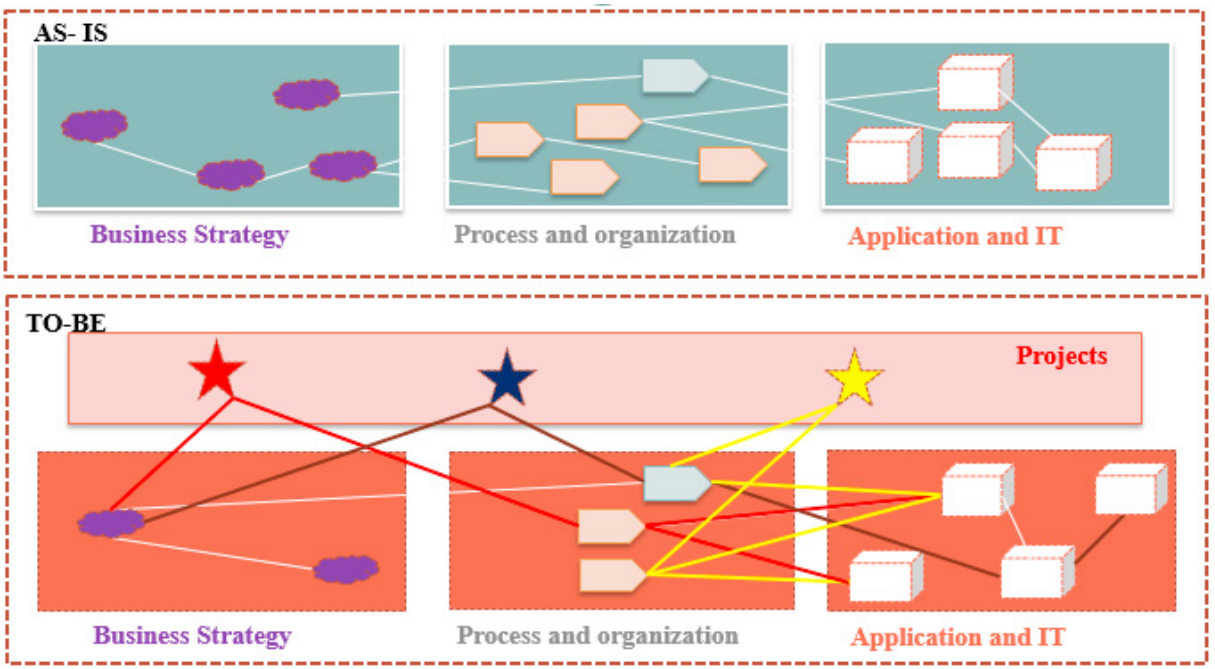

Fig.1 : The objective of the CBITA Approach

The objective is to integrate a new project in the company by analyzing the change that will impact the elements by comparing the study of the existing (AS IS) with the target to maintain (TO BE) taking into account the modeling of the project and integrating the urbanization model of the French state as a reference for the meta model.

The contribution will begin with an approach that has three important phases, as shown in Fig.2. It includes:

- Pre-requisite: Study of the existing "AS-IS" using the French government's information system urbanization repository;
- Modeling of the IT project: Modeling of the project with different missions and processes of different levels of abstraction (same repository as AS-IS but with the project objectives);
- Change analysis: In order to determine if the project can be adopted by AS-IS, a comparison is needed to determine what changes will be supported.

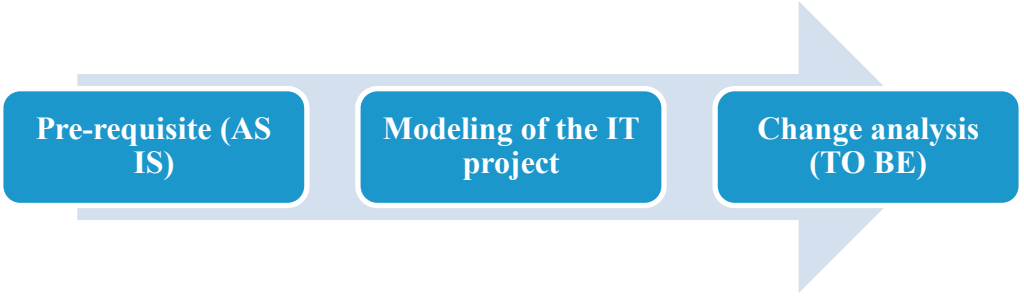

Fig. 2 : CBITA Approach

3. Algorithms for change analysis

The elaborated algorithms will be defined in correspondence with the CBITA approach and taking into consideration the CBITA-P (Change in Business IT Alignment-Prototype), the prototype that will be developed to support the impact of change analysis on the strategic alignment proposed in the approach. The dedicated algorithms for the validation of the approach will execute this prototype.

The purpose of this prototype is to provide an editor to compare the CSV files: AS IS and TO BE. This files are exported from the Archi modeling tool which is our editor for modeling the AS IS model, the project (Change) and the TO BE taking into consideration the French state IS urbanization meta model and running the algorithms that will be developed.

Prototype CBITA- P provides access to: (1) exporting the CSV files and visualizing them, (2) comparing the two files and demonstrating the comparison between the alignment elements, (3) analyzing the impact of the change, and (5) quantifying the best project impact for the strategic alignment.

The prototype will be developed in JAVA. The JFreeChart library is used to represent the statistics of the measures exploited by algorithms in the form of graphs. The results are saved in a database, which will be exploitable afterwards.

3.1. Measurement framework for algorithms

Despite all the state of the art agility metrics on levels of abstraction seen in our previous research [1], no metric or measure influenced us to be able to calculate the impact of the change. We opted for an adequate solution to be able to boost our data and have a result of this change.

The solution is to create a comparison tool between the AS IS and TO BE file after its impact. As we all know, we cannot write an algorithm using Sql language, and our solution needs Sql queries to analyze the data in the CSV files. We opted for a coding of the queries by putting them in a table explaining the result of the query and appealing the query by the code initiated in the algorithm query to introduce the logic of the tool.

In order to facilitate the reading and understanding of each algorithm, we will use the framework presented in the table 1 below:

Table 1 . Understanding of algorithms

Acronym	The acronym of the algorithm
Name	Name of the algorithm
Definition	Definition of the algorithm
Criteria	Criteria of the algorithm
SQL encoding	SQL query

We will start with the data import algorithms and then the comparison between the CSV files with the AS IS and the TO BE of the projects.

3.1.1. Algorithm 1 : CSV file data import algorithm

This algorithm allows importing data from CSV files to a database; we will use the measurement frame table

Acronym	**ImportFileCSV** : Data import from CSV file
Name	Algorithm for loading data
Definition	This algorithm allows the import of data from CSV files to a database to manipulate the data and do an impact analysis. The algorithm opens the CSV file, reads the file and executes the CODE001 query to insert the data from the file to the database

Criteria	CSV file NonFF, The data in the CSV file includes an ID, Name of the entity, Type of the entity and documentation.
CODE001	Insert into element (ID, TYPE, Name, Documentation, Projet) values (?,?,?,?,?)"

Algorithm 1 : ImportFile CSV

```
DATA
        F1 : Files
        Rqt : Sql query which brings the elements 'AS IS ' or 'TO BE'
        T-ResultatRqt : array [1...N]

begin
F1 ⇐ Open ('As Is.CSV') // or ('To Be. CSV')
Read fichier (F1)
   while (NonFF (F1)) then
    Execute the query number Code001
    T-ResultatRqt ⇐ Rqt
    Display ("The data are imported")
   End while
End
```

3.1.2. Algorithm 2 : Algorithm for loading data by project

Acronym	**FetchCSVtoBdd** : Importing CSV data from the Database
Name	Algorithm for loading data by project
Definition	This algorithm follows the 1st algorithm 'ImportFileCSV' which allows to import the data from the DB by project and display them in the CBITA-P tool, by executing the query CODE002 of the data selection for each initiated project
Criteria	Data redundancy per project
CODE002	As Is : select Projet, ID, Type, Name, Documentation from element where projet = i To Be : select Projet, ID, Type, Name, Documentation from element_tobe where projet = i

Algorithm 2 : FetchCSVTOBDD

```
DATA
        Rqt : Sql query which brings the elements 'AS IS ' or 'TO BE' by projects
        T-ResultatRqt : Array (1...N) : result of Sql query
        i : integer

begin
Execute the query number Code002
for i⇐ 1 à N do
   A(i) ⇐T-ResultatRqt
     if A(i) = '1' then
        i ⇐ 'Projet1'
       display ("The data are imported for Projet1", A(i))
     Else if A(i) = '2' then
            i ⇐ 'Projet2'
            display ("The data are impoted for Projet2", A(i))
            Else if  A(i) = '3' alors
                  i ⇐ 'Projet3'
```

```
            End if
    End if
next i
 End for
End
```

3.1.3. Algorithm 3 : Algorithm that calculates the number of impacted entities per project

Acronym	**NbrElmtPrjct** : Number of impacted elements per project
Name	Algorithm that calculates the number of impacted entities per project
Definition	This algorithm allows us to calculate the number of entities (business process, objectives, resources...) for the study of the existing and for its impact with the different projects to stimulate the difference between the two models after the analysis of the change by alignment entity
Criteria	Number of impacting alignment elements per project
CODE003	As Is : SELECT Projet, TYPE, COUNT(*) as Nbr FROM element GROUP BY TYPE, Projet To Be : SELECT Projet, TYPE, COUNT(*) as Nbr FROM element_tobe GROUP BY TYPE, Projet

Algorithm 3 : NbrElmtPrjct

```
Data
        Rqt : SQL query that brings the number of impacted elements
        Nbr-Elmt : Result of SQL query
        A : Array [1...n]

begin
Execute the query number Code003
for i⇐ 1 à N do
   A(i) ⇐ Nbr-Elmnt
    if A(i) = '1' then
    i ⇐ 'Projet1'
    display ("Number of elements impacted is", A(i)," for the project 1 :", i)
    Else if A(i) = '2' then
          i ⇐ 'Projet2'
          display ("Number of elements impacted is", A(i)," for the project 2 :", i)
          Else if A(i) = '3' then
                i ⇐ 'Projet3'
               display ("Number of elements impacted is", A(i)," for the project 3 :", i)
          end if
     End if
 End if
Next i
 End for
end
```

3.1.4. Algorithm 4 : Comparison algorithm for Csv As Is and To Be files

Acronym	**ImpactChangeElmntASIS-Tobe/Project** : Impact of changing alignment elements between As Is and To Be by project

Name	Comparison algorithm between AS IS and TO BE
Definition	This algorithm allows us to compare the data of the study of the existing with the data of the file To Be by each project, which is the impact on the As Is taking into consideration the modeling of archimate, based on the strategic alignment. The comparison will evoke the number of entities that have been changed by project, defining the acquired change: modification of alignment elements, deletion of alignment elements or addition of new alignment elements, it can be business processes, objectives, functions, actors ...
Criteria	Number of impacted alignment elements supporting the change per project
CODE004	Add : Select (Select Count(ID) from element_tobe) – (Select Count(ID) from element) as Add
CODE005	Update : Select count(*) from (select count(Name) from element group by Name Having count(Name) > 1As Update
CODE006	Delete : Suppression : Select (select count(ID) from element) – (Select Count(ID) from element_tobe) AS delete

Algorithm 4 : ImpactChangeElmntASIS-Tobe/Project

```
data
        Rqt1 : Integer // SQL query that brings the added elements
        Rqt2 : Integer // SQL query that brings the modified elements
        Rqt3 : Integer // SQL query that brings the deleted elements
       Add : Integer// Result Rqt1
        Update : Integer // Result Rqt2
        Delete : Integr // Result Rqt3
        NbrAdd : Array
        NbrUpdate : Array
        Nbrdelet : Array
begin
Execute the query number Code004
Execute the query number Code005
Execute the query number Code006
Add ⇐ Rqt1
Update ⇐ Rqt2
Delete ⇐ Rqt3
for i ⇐ 1 à Add DO
   if Add > 0 then
       NbrAdd (i) ⇐Add
  End if
Next i
End for I
for j ⇐ 1 à Update do
    if Update > 0 then
        NbrUpdate⇐Update
    End if
Next j
End for j
for L ⇐ 1 à delete do
     if delete > 0 alors
          Nbrdelet ⇐ delete
     End if
```

```
Next L
End for
        display ("Impact of changing the alignment elements between As Is and To Be are :Added ", NbrAdd, "
                                        for modificiation : ", NbrUpdate, "for deleted :", Nbrdelet)
End
```

4. Conclusion and perspective

In this document, we have presented the CBITA approach for our contribution, the CBITA approach to satisfy the following expected points through three essential steps:

- Model the Meta model of step 1 - AS IS based on the French state IS urbanization referential.
- Model the project, which is the impact of the change on the strategic alignment, and prioritize the project by a project sheet.
- Mitigate to a To Be after the impact of the project which will also be modeled by the Meta model of the French state IS urbanization referential.

In addition, in this document we have presented the second contribution of the CBITA approach through the proposal of algorithms for the evaluation of the impact analysis of the change on the strategic alignment of information systems. The proposed algorithms gather a considerable amount of data from CSV files that participate in the comparison between the As Is and the To Be and that offer an explanation to the architects during the whole evaluation process.

The impact of the change on the alignment is considered critical and thus requiring the implementation of corrective actions. On the other hand, and with the objective of considering each element differently from the others according to its priority, we introduced the notion of analyzing this impact by focusing on the strategic alignment entities that can be either modified, deleted or added to other entities requiring this impact.

In our next work, we will present the modeling of the Meta model of the CBITA steps by the Archimate tool, present the CBITA-P prototype (Change Business IT Alignment - Prototype) developed to support the modeling of the impact of change on the strategic alignment of the information systems proposed in the CBITA approach. The purpose of this prototype is to provide the user with the ability to define a comparison between the As Is and To Be files per impacted project, running the associated algorithms to be able to know the best quantifiable project after its impact on the As Is for the aligned system of the company. In addition, present the case of impact study of three projects on an urban agency.

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