Project Line: Formally Specifying the Domain of Balanced Scorecard

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Abstract

In today's world, in both the public or private organizations, there exists the problem that the strategies, that are the only sustainable forms that the organizations have to create value, are changing, but the tools to measure them are not. On the other hand, in the current economy, the intangible assets are most important sources of competitive advantages, and it's necessary to have tools that describe assets based on knowledge and strategies for value creation. Without these tools, the organizations have difficulties to manage things that they are not able to describe or measure. Also, there exists a scheme to support the organizational management, called Balanced Scorecard, that enables organizations to clarify their vision and strategy, and translate them into action.

There are not too much integrated tools that carry from strategic mapping to Balanced Scorecard. We believe that if this scheme has an automated solid base to help the management of the projects and the organization, the managers will have the possibility to make decisions with bigger speed and accuracy, as well as to observe the deviations of the reality regarding the desirable thing with more anticipation.

Here, we present a first proposal for formally construct tools to support the Balanced Scorecard in the organizational environment. In order to construct high quality software, it is important to formally outline the specification of the domain and the requirements. We do this in RAISE Specification Language, and its RAISE method, because of its intended use on real developments in the software industries. This language and this method are formal, but it allows intermediate specifications not formal –rigorous–and it is sufficiently flexible to conveniently work with distinct degrees of formality without the strict techniques required by the formal methods.

Keywords: Software Engineering, Formal Methods, Management, CAM.

1. Introduction

The capacity to execute a strategy is more important that the quality of the strategy itself. The application of the strategy is the most important factor on the valuation of a enterprise and its management [1-3]. A problem is that the strategies, that are the only sustainable forms that the organizations have to create value, are changing, but the tools to measure them are not. More recent studies have estimated that by the end of the 20th century, the countable value of the tangible assets represented only from 10% to 15% of market value of the enterprises. It is clear that to create value opportunities, we are going from material asset management to management of strategies based on knowledge that develop the immaterial assets of the organization: relations with clients, innovative products and services, efficient operating processes of high quality, information technology and databases, and also employees capabilities, skills and motivations.

In the current economy, however, where intangible assets are most important sources of competitive advantages, it's necessary to have tools that describe assets based on knowledge and strategies for value creation. Without these tools, the enterprises have difficulties to manage things that they are not able to describe or measure [4]. The organizations need a type of management system to be explicitly designed to manage the strategy, not the tactic [5].

The strategy application requires, therefore, that all employees, as well as all business units and support units, be aligned and linked to the strategy. And with the quick changes in technology, competition and regulations, the formulation and application of the strategy should be a continuous and participative process. The current organizations need a language that allows them to communicate the strategy, as well as processes and systems that help them to implement it and to obtain information or feedback on it. The Balanced Scorecard became a tool to manage the strategy.

2. Review of Balanced Scorecard

A approach to strategic management was developed in the early 1990's by Drs. Robert Kaplan (Harvard Business School) and David Norton (Balanced Scorecard Collaborative) [6-8]. They named this system the 'balanced scorecard'. Which provides a prescription as to what companies should measure in order to 'balance' the financial perspective.

The Balanced Scorecard is a ***management system*** (not only a measurement system) that enables organizations to clarify their vision and strategy and translate them into action. It provides feedback around both the internal business processes and external outcomes in order to continuously improve strategic performance and results [9].

The following four figures show the central point of its definition.

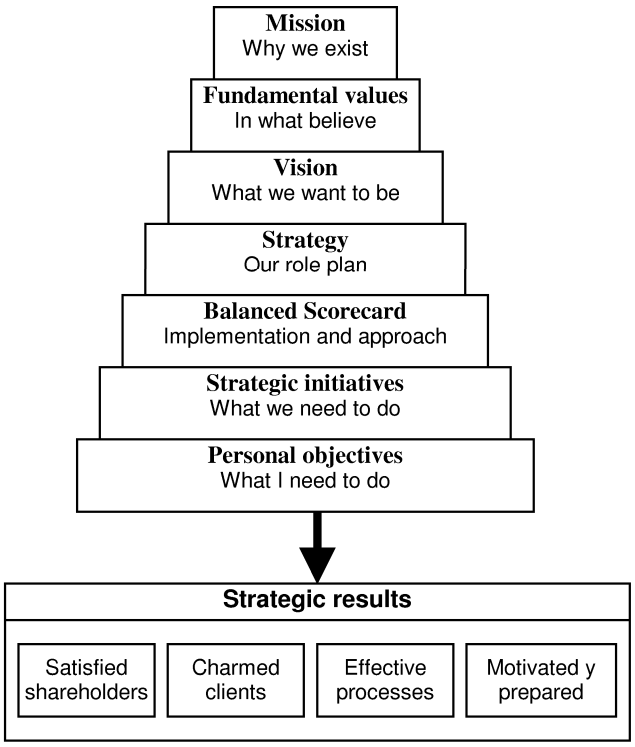

Figure 1. Translation a mission to searched results.

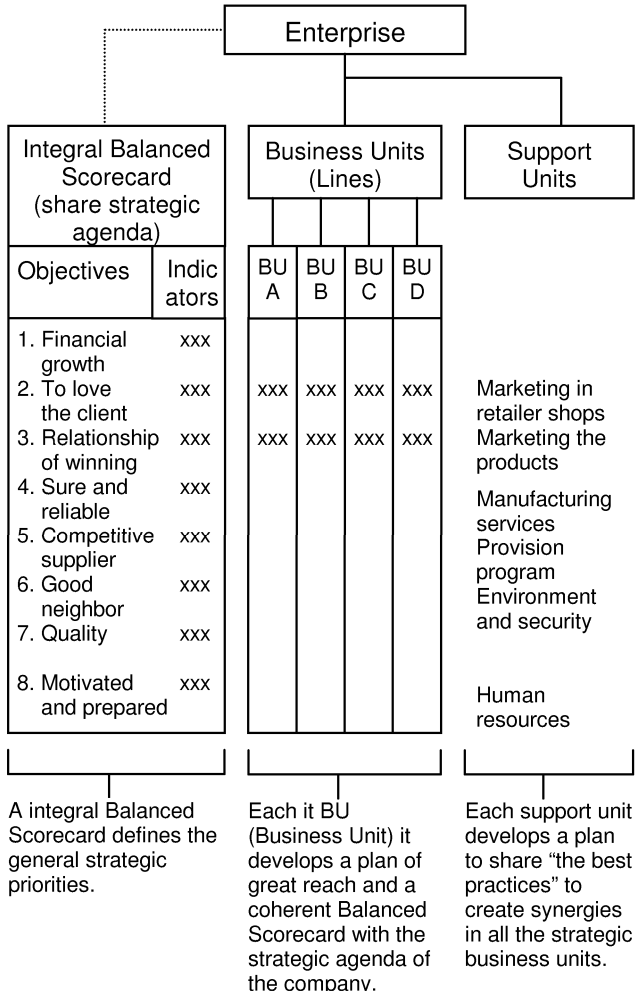

Figure 3: Linking of integral Balanced Scorecard of organizational strategy with Balanced Scorecard of shared support services and business units.

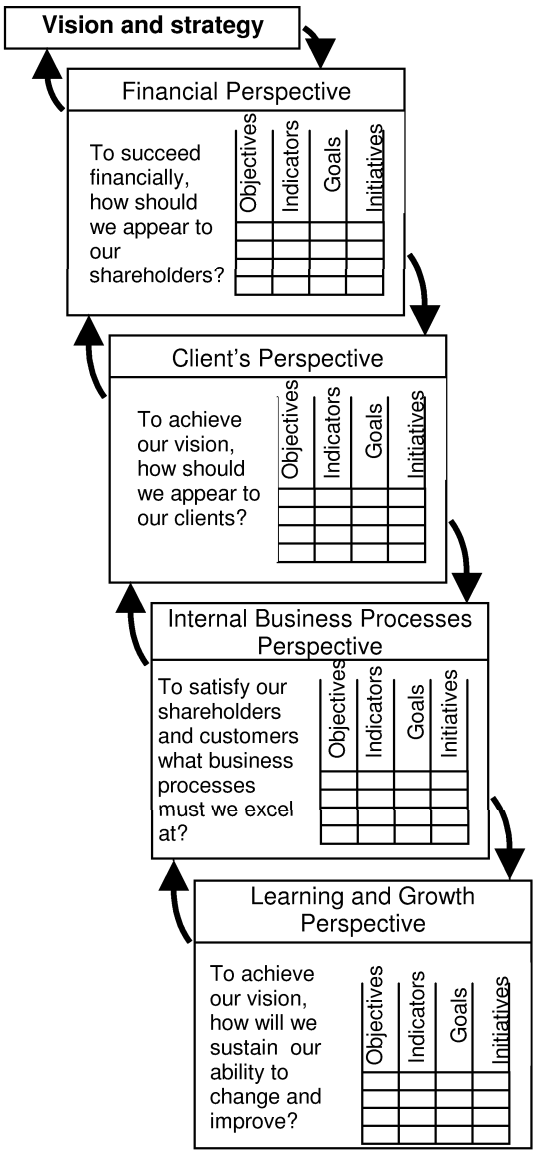

Figure 2. Definition of the cause-effect relationships of the strategy.

Financial perspective	Client perspective	Internal processes perspective	Learning and growth perspective
To optimize the distribution of capital (value for shareholders) To balance the growth with the risk (rate of the investment adjusted to the risk)	To promote the crossed sale (to share bank accounts) To be centered in the client (satisfaction and fidelity of client)	To optimize shared processes: -Infrastructure -Acquisitions -Bookcases space Scale economies: -Distribution -Manufacture To integrate of chain of value (Cost by unit) (Quote of market)	Share better practices To develop key skill

Figure 4. Practical example of the spectrum of organizational synergies.

3. Formalization of the Domain in RAISE Specification Language

We first present the stakeholders specification, as integral part of the Balanced Scorecard management system. Then, we present additional components needed to form the complete specification for integral and strategic Balanced Scorecard concepts. Some ideas have been taken from the technical reports published by Dines Bjørner [10-12]. The syntax and the semantic are based on the RAISE specification language [13] and the specifications are presented in five different sections for clarity of the readers.

RAISE is an acronym for "Rigorous Approach to Industrial Software Engineering". RAISE takes the word "industrial" seriously. The method is intended for use on real development, not just toy examples. The method is based on a number of principles: separate development, step-wise development, invent and verify, and rigor [14].

In this first work, we are centered on the specification of Balanced Scorecard domain. We try to distinguish between the domain analysis and the product analysis. Here we begin with the first domain specification as shown.

Specification 1: The ***stakeholders*** (interested parts) can be formally defined as shown below:

The BSC of the interested parts (stakeholders) identifies to main constituent parts of the business –shareholders, clients and employees– and also some others like the suppliers and the community.

```
scheme STAKEHOLDERS =
 class
  type
   Stakeholder,
   Main_Stakeholder = {| s:Stakeholder •
         is_Main_Stakeholder(s) |},
   Secondary_Stakeholder = {| s:Stakeholder
         • is_Secondary_Stakeholder(s) |},
   Client ={|s:Stakeholder • is_Client(s)|},
   Employee = {| s:Stakeholder •
         is_Employee(s) |},
   Shareholder = {| s:Stakeholder •
         is_Shareholder(s) |},
   Supplier = {| s:Stakeholder •
         is_Supplier(s) |},
   Community = {| s:Stakeholder •
         is_Community(s) |}
  value
   is_Client : Stakeholder -> Bool,
   is_Employee : Stakeholder -> Bool,
   is_Shareholder : Stakeholder → Bool,
   is_Supplier : Stakeholder → Bool,
   is_Community : Stakeholder → Bool,
   is_Main_Stakeholder: Stakeholder → Bool
   is_Main_Stakeholder(s) ≡
      is_Client(s) ∨ is_Employee(s) ∨
      is_Shareholder(s),
   is_Secondary_Stakeholder :
      Stakeholder → Bool
   is_Secondary_Stakeholder(s) ≡
        is_Supplier(s) ∨ is_Community(s)
  axiom
   ∀ s : Stakeholder •
     is_Shareholder(s) ⇒
       ~is_Client(s) ∧ ~is_Supplier(s),
   ∀ s : Stakeholder •
     is_Client(s) ⇒ ~is_Shareholder(s),
   ∀ s : Stakeholder •
     is_Supplier(s) ⇒ ~is_Shareholder(s)
end
```

Specification 2: The strategic structure, i.e. the ***translation from the mission to searched results*** (pointing to reach Total Quality Management) to construct the strategy can formally be defined as follows:

```
STAKEHOLDERS
scheme STRATEGIC_STRUCTURE =
extend STAKEHOLDERS with
 class
  type
   Mission, Fundamental_Values, Vision,
   Strategy, Integral_BSC, Goal, Time,
   Strategic_Initiatives,
   Personal_Objectives,
   Actual_Indicator = Indicator,
   Management_Indicator = Indicator,
   Final_Indicator = Indicator,
   Result_Indicator = Indicator,
   is_Actual_Indicator,
   is_Management_Indicator,
   is_Final_Indicator, is_Result_Indicator,
   Strategic_Results, Value = Real,
   Deviation = Real,
   Indicator = {| (g, v, t, ld, rd) :
    (Goal×Value×Time×Deviation×Deviation) •
    is_Indicator(g, v, t, ld, rd) |},
   Total_Quality_Management ==
    Total_Quality_Management_1 |
    Total_Quality_Management_2,
   Total_Quality_Management_1 =
    {| (g, ai, mi) : (Goal ×
    Actual_Indicator× Management_Indicator)•
    is_Total_Quality_Management(g,ai,mi)|},
   Total_Quality_Management_2 =
    {| (g, fi, ri) : (Goal ×
    Final_Indicator × Result_Indicator) •
    is_Total_Quality_Management(g,fi,ri)|}
  value
   M_FV : Mission -m-> Fundamental_Values,
   FV_V : Fundamental_Values -m-> Vision,
   V_S : Vision -m-> Strategy,
   S_IBSC : Strategy -m-> Integral_BSC,
   IBSC_SI : Integral_BSC -m->
    Strategic_Initiatives,
   SI_PO : Strategic_Initiatives -m->
    Personal_Objectives,
   PO_G : Personal_Objectives × Employee -m->
    Goal,
   PO_Indicators_SR : Personal_Objectives ×
    Management_Indicator × Result_Indicator
```

```
  → Strategic_Results,
 is_Actual_Indicator,
 is_Management_Indicator,
 is_Final_Indicator,
 is_Result_Indicator : Goal × Value ×
  Time × Deviation × Deviation → Bool,
 is_Indicator : Goal × Value × Time ×
  Deviation × Deviation → Bool
 is_Indicator(g, v, t, ld, rd) ≡
  is_Management_Indicator(g,v,t,ld, rd) ∨
  is_Result_Indicator(g, v, t, ld, rd) ∨
  is_Actual_Indicator(g, v, t, ld, rd) ∨
  is_Final_Indicator(g, v, t, ld, rd),
 is_Total_Quality_Management :
  Goal × Indicator × Indicator → Bool,
 precede : Time × Time -> Bool
axiom
 ∀ d : Deviation • d ≥ -100.0 ∧ d ≤ 100.0,
 ∀ (g1, v1, t1, left_dev_allow1,
    right_dev_allow1) : Result_Indicator,
   (g2, v2, t2, left_dev_allow2,
    right_dev_allow2): Result_Indicator •
  g1 = g2 ⇒ v1 = v2 ∧ t1 = t2 ∧
    left_dev_allow1 = left_dev_allow2 ∧
    right_dev_allow1 = right_dev_allow2,
 ∀ g1 : Goal, (g2, vactual, tactual,
     left_dev_actual, right_dev_actual) :
     Actual_Indicator,
             (g3, vdesirable, tdesirable,
     left_dev_allow, right_dev_allow) :
     Management_Indicator •
   g1 = g2 ∧ g2 = g3 ∧
   (vactual - left_dev_actual) ≤
     (vdesirable - left_dev_allow) ∧
   (vactual + right_dev_actual) ≤
     (vdesirable + right_dev_allow) ∧
   precede(tactual, tdesirable) ⇒
   is_Total_Quality_Management(g1,
     (g2, vactual, tactual,
      left_dev_actual, right_dev_actual),
     (g3, vdesirable, tdesirable,
      left_dev_allow, right_dev_allow)),
 ∀ g1 : Goal,
  (g2, vfinal, tfinal, left_dev_final,
   right_dev_final) : Final_Indicator,
  (g3, vdesirable, tdesirable,
   left_dev_allow, right_dev_allow) :
  Result_Indicator •
  g1 = g2 ∧ g2 = g3 ∧
  (vfinal - left_dev_final) ≤
   (vdesirable - left_dev_allow) ∧
  (vfinal + right_dev_final) ≤
   (vdesirable + right_dev_allow) ∧
  precede(tfinal, tdesirable) ⇒
  is_Total_Quality_Management(g1,
    (g2, vfinal, tfinal, left_dev_final,
     right_dev_final),
    (g3, vdesirable, tdesirable,
     left_dev_allow, right_dev_allow))
end
```

With the last expression, we are specifying the is_Total_Quality_Management predicate, which evaluates to true if all system Actual_Indicator are valid into Management_Indicator, and all system Final_Indicator are valid into Result_Indicator at end of time.

The Balanced Scorecard of the interested parts (stakeholders) provides Balanced Scorecard of the key indicators of activity. Where the second factor of Result_Indicator, which is a Real, determines "the desirable value" to obtain as result on the measure of its Goal. Similarly, the second factor of Management_Indicator determines "the actual value" that it measure of its Goal.

Examples of values for Personal_Objectives type are by:

- a Client as Main_Stakeholder is: "An excellent place to buy"
- a Employee as Main_Stakeholder is: "An excellent place to work"
- a Shareholder as Main_Stakeholder is: "An excellent place to invest"

Specification 3: We formalize the ***translation from the strategy to operative terms*** (from strategic approach to tactic approach) as expressed below:

```
STRATEGIC_STRUCTURE
scheme STRATEGY_TO_TACTICS =
extend STRATEGIC_STRUCTURE with
 class
  value
   Describe_Strategy :
    Strategy × Main_Stakeholder →m
    Strategic_Initiatives,
   Execute_Strategy :
    Strategic_Initiatives →m
    Personal_Objectives × Indicator
 end
```

Specification 4: The four Balanced Scorecard ***perspectives*** can be specified as follows:

```
STRATEGY_TO_TACTICS
scheme PERSPECTIVES =
extend STRATEGY_TO_TACTICS with
 class
  type
   Financial_Perspective, Financial_Terms,
   Profits, Clients_Perspective, Clients,
   Valor_Proposition, Reengineering,
   Products_and_Services_Innovation,
   Clients_Management_Processes,
   Internal_Processes_Perspective,
   Internal_Processes, Technology_List,
   Learning_and_Growth_Perspective,
   Employees, Skills, Capabilities
  value
   FP : Strategy × Financial_Terms →m
    Financial_Perspective × Profits,
   CP : Strategy × Clients →m
    Clients_Perspective × Valor_Proposition
    ×Products_and_Services_Innovation
    × Clients_Management_Processes,
```

```
   IPP : Strategy × Internal_Processes →m
    Internal_Processes_Perspective ×
    Technology_List × Reengineering,
   LaGP : Strategy × Employees →m
    Learning_and_Growth_Perspective ×
    Skills × Capabilities
end
```

Where Strategy, Clients and Employees types are defined as above.

Specification 5: Finally, the ***complete Balance Scorecard management system concept*** can be formally defined as showed below:

```
PERSPECTIVES
scheme BSC =
extend PERSPECTIVES with
 class
  type
   BSC
  value
   BSC : Financial_Perspective ×
         Clients_Perspective ×
         Internal_Processes_Perspective ×
         Learning_and_Growth_Perspective ×
         Strategic_Initiatives ×
          /* Strategy × Main_Stakeholder */
         Secondary_Stakeholder ×
         Strategic_Results
          /* Goal, Employee,
             Personal_Objectives,
             Management_Indicator,
             Result_Indicator */
         →m Bool
  axiom
   ∀ g : Goal, i1 , i2 : Indicator •
    is_Total_Quality_Management (g, i1, i2)
end
```

There is an overload of definition on Strategic_Integral_BSC because it should be the same concept and content, viewed from three different angles:

- from strategic BSC of stakeholders (each stakeholder has their own BSC, plus the internal processes),
- from the four perspectives, that is the strategic map plus desirable results,
- from business units, i.e. the internal synergy that contribute each of strategic business units.

4. Conclusions

The scheme to support the organizational management, called Balanced Scorecard, is useful in the organizations, but there are not too much integrated tools that carry from strategic mapping to Balanced Scorecard. We have proposed a first proposal for the construction of tools to support the Balanced Scorecard in the organizational environment. Then, in this first step we formally model the domain of Balanced Scorecard.

For constructing high quality software, it is important to formally outline the specification of the domain and the requirements. We do this in RAISE Specification Language, and its RAISE method, to develop industrial software. This language and this method is not formal, but it is rigorous and it is sufficiently flexible to conveniently work without the techniques required by the formal methods.

In this first approach, we give the specifications of the domain, that they will serve for to outline a general scheme to start to define tools, environments and interfaces to obtain a general framework for supporting the Balanced Scorecard management system.

It is desirable, in the future, to develop an automated solid base to take the management of the projects and of the organization in general. Thus, the managers will have the possibility to make decisions with bigger speed and accuracy, as well as to observe the deviations of the reality regarding the desirable thing with more anticipation.

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