Schema Integration Process for UBSMM

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1 Introduction

Unifying business strategy formulation meta-models can be achieved through schema integration [1], where schema integration refers to both view integration and database integration. There exist various efforts on schema integration [1,2,3]. The foundational work of [4] compares methodologies for integrating view and database schemata around four phases: pre-integration, schema comparison, conforming to schemata, and merging and restructuring. These phases appear in schema integration methods in varying ways. For example [1,2] take a three phase approach on integrating schemata applying the principles of [4] in a condensed manner; [1]'s three phases are integration comparison, schema conforming and schema merging [1], and [2]'s pre-integration, correspondence identification and integration.

2 Pre-integration

This first phase of schema integration includes the selection of schemata to be integrated (based on relevance, completeness and reliability), the selection of schemata' representations, the integration order, and assignment of preferences and strategic decisions for integration, e.g. the involvement of users or designers along with relevant information collected for an integrated set of constraints depending on the view (user, designer, etc.).

2.1 Select schemata for integration.

For reviewing business strategy formulations, JSTOR and Google Scholar have been used to find publications in journals, conference proceedings, books and reports querying terms such as "business strategy", "business strategy formulation", "strategy", "strategic planning", and "strategic management". JSTOR is one of the biggest online systems archiving academic journals; http://www.jstor.org/) and Google Scholar is a web search engine indexing scholarly literature provided by the world's dominant search engine, Google; http://scholar.google.com/. Criteria for relevance included; the title or abstract of the source referring to business strategy approach, the source referring to a distinct business strategy formulation and the source referring to practical applications of such formulation. Findings on business strategy formulations include the following:

- Miles & Snow Typology [5],
- The Value Chain [6],
- The Value Shop and The Value Network [7],
- Blue Ocean Strategy [8],
- Strategy Maps & Balanced Scorecards [9].

Miles & Snow Typology.

Miles & Snow [5] proposed a theoretical framework, the adaptive cycle, which identifies three broad problems of organizational adaptation to the environment; the entrepreneurial problem, the engineering problem and the administrative problem. The entrepreneurial problem deals with establishing a particular business-product-market domain for the firm, the engineering problem deals with developing a system that materializes the entrepreneurial problem's solution, the administrative problem deals with stabilizing and reducing the uncertainty of the activities and structures used to solve the engineering problem, and thus solve the entrepreneurial problem. Additionally, Miles & Snow [5], have put forward an empirical strategic typology capturing the means organizations can use to move around the adaptive cycle; organizations as defenders, analyzers, prospectors, and as reactors.

Desarbo et al. [10] inspired by the Miles & Snow typology, conducted an empirical study to derive a strategic typology with richer insights on a company's strategic standpoint. More companies were examined and more variables were identified, e.g. strategic capabilities, environmental uncertainties and performance given that a company's choice of strategy relies on its capabilities and environment. Their typology is based on measures for five basic strategic capabilities (market-linking, technology, marketing, information technology, and management), the operational environmental uncertainty and performance data collected. They concluded into 4 groups with different areas of strength and focus.

The Value Chain.

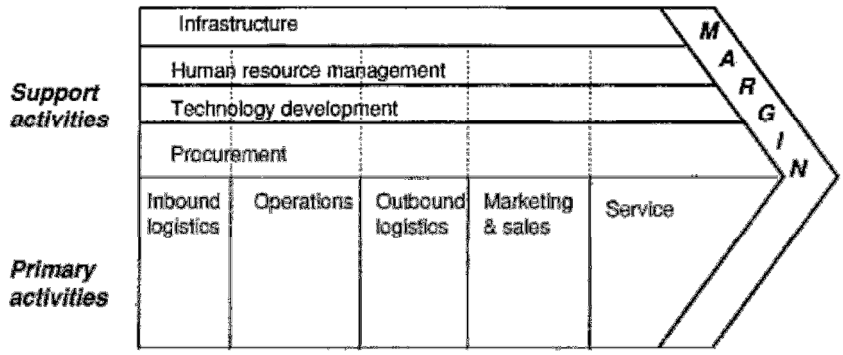
Michael Porter's work is focused on competition arguing there are two options for success in a competitive environment; differentiation and low cost [6]. Accompanied with a company's desired targeted market segment they result into three generic strategies; cost leadership, differentiation and focus.

Porter's value chain highlights a company's strategy and strategy implementation depending on how the activities are carried out (figure below). It consists of value activities and margin. Value activities are all the activities a company performs to create value for its buyers, divided into primary and support, while margin is the difference between the total value and the total cost of performing the value activities.

From a competitive advantage perspective and across primary and support activities, activities are further grouped into three types: direct, activities that create value, indirect, activities that allow the direct one to be performed and quality assurance, ensuring the quality of direct and indirect activities.

Each activity is classified based on its contribution to a firm's competitive advantage, primarily from an economic view; those that have high impact of differentiation and those that have a considerable proportion of cost.

Value activities interact with each other within the value chain via linkages, which are relationships between the way a value activity is performed and the cost of another (represented as dotted lines). They support optimization and coordination among value activities, thus competitive advantage.

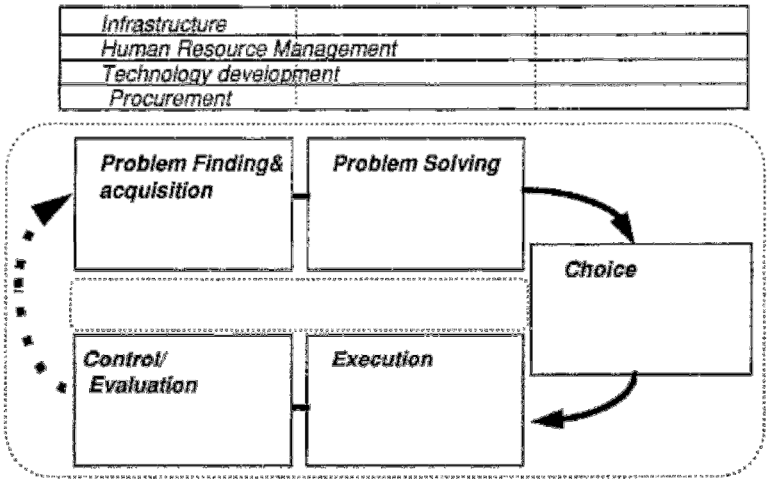


Linkages may exist between multiple value chains (e.g. firm and suppliers). Porter identifies ten generic drivers for cost and value, which shape the competitive position of the firm: scale, capacity, utilization, linkages, interrelationships, vertical integration, location timing, learning, policy decisions and government regulations.

Value chains are linked sequentially (suppliers, producers, and distributors) by adding value to what the preceding activity has produced, whereas the value creation logic is focused on cost, towards a desirable margin.

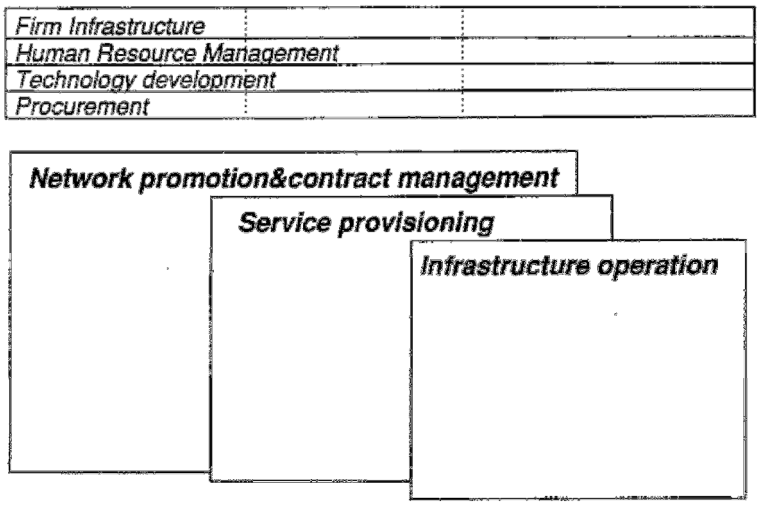
The Value Shop & the Value Network.

Stabell and Fjeldstad [7] introduced a third generic strategy, the choice of value configuration, extending Porter's cost leadership and differentiation. They extend the value chain by introducing the value shop (figure below), where value is created by using resources and activities to resolve a customer problem and the value network (figure below), where value is created by facilitating relationships among a network of enterprises and their customers via a mediating technology.



Value shops are linked spirally interchanging problem-solving and implementation activities and the value creation logic focuses on value. Value networks are linked

simultaneously and in parallel forming horizontally interconnected activities while the value creation logic focuses on balancing cost and value.

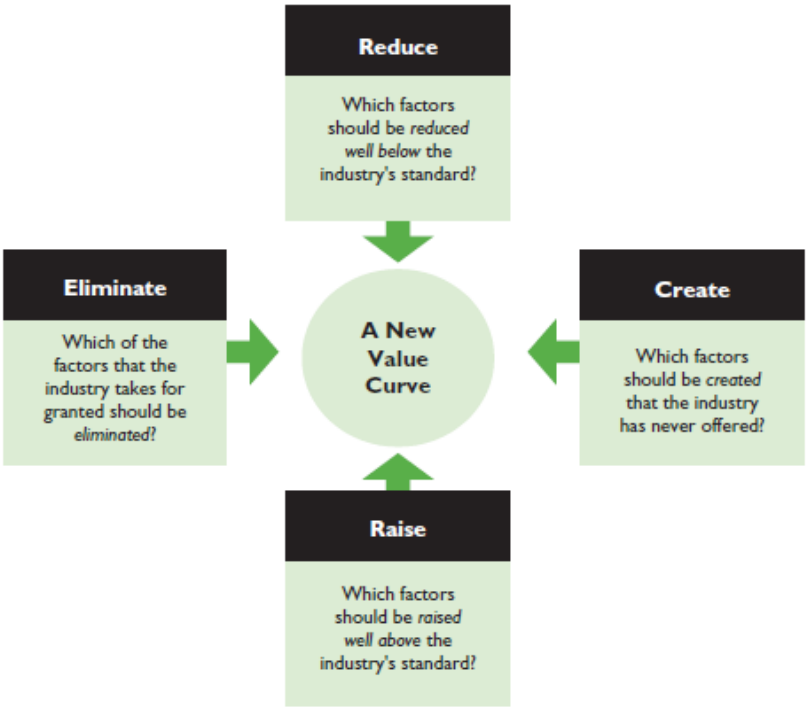


Blue Ocean Strategy.

The Blue Ocean Strategy approach [8] focuses on unknown market space thus aims at competing where there are no competitors.

Industry's structural conditions are not considered fixed and therefore, the objective is neither differentiation nor low cost. Everything can be reconstructed thus aiming at breaking the existing rules and creating new ones.

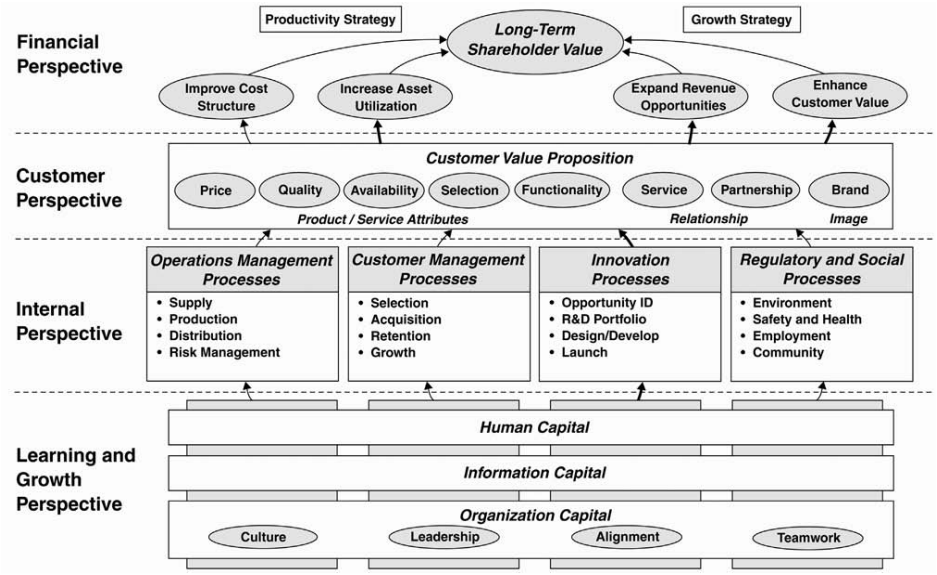
The framework consists of the strategy canvas and the four actions framework. The strategy canvas, which offers a graphical representation of the current state in a known market by identifying the range of factors an industry competes on and invests in (horizontal axis) as well as their offering level to buyers (vertical axis). A basic component of the strategy canvas is the value curve capturing a company's relative performance across the aforementioned competition factors of a given market.



The four actions framework (figure above) challenges current strategic logic and drives change. Eliminating and reducing focuses on dropping the current cost structure, whereas, creating and rising strive for how-to in terms of lifting buyer value and creating new demand. With the assistance of the eliminate- reduce-raise-create grid, the four-action framework goes beyond analysis by pushing for action and thus creates a new value curve.

Strategy Maps & Balanced Scorecards.

Strategy maps and balanced scorecards (SMBSC) have been proposed by Kaplan and Norton to represent, communicate and monitor strategy as well as the achievement of strategic objectives. A strategy map serves as a mediator between the mission, core values, the vision and the strategy of an enterprise to the work performed. Kaplan and Norton have proposed a template for strategy maps (figure 6) representing how an organization can create value [9], which places the framework as one of the few providing means for visual representation of strategy. The recommended way to build a strategy map is to follow a top down manner, starting from a mission statement and core values to develop a strategic vision, which should project the organization's overall goal.



Scorecards consist of strategic objectives and related measures, which include concrete targets and initiatives towards their achievement (Kaplan & Norton, 1996). Scorecards are structured with cause-effect links/assumptions and their monitoring and assessment is essential for identifying interdependencies across an organization. According to [11], balanced scorecards (BSC) present an organization's business activities through a number of measures typically from four organizational perspectives: financial, customer, internal, learning and growth, and provides a language to communicate priorities within an enterprise. A scorecard is considered balanced (BSC) due to the four perspectives that provide complete coverage of business processes, while the time aspect is addressed indirectly via short term targets set and also via the bottom up view of the four perspectives suggesting that what lies on the bottom is the outcome of planning at the top and is a prerequisite. Additionally a scorecard is also considered balanced because it covers both the internal as well as the external aspects of an enterprise.

A strategy map is a general representation of the four organizational perspectives of the BSC [12] in a cause-effect manner and facilitates the communication of direction and priorities across the enterprise and according to Kaplan and Norton (2004b). It is based on five principles:

- Strategy balances long-term financial commitments aiming at profitable revenue growth and short-term financial commitments aiming at cost reductions and productivity improvements (financial perspective).
- Strategy is based on differentiated and clearly articulated customer value proposition (customer perspective).
- Value is created through focused, effective and aligned internal business processes grouped into four clusters: operations management, customer management, innovation and regulatory and social (internal perspective).
- Strategy consists of simultaneous, complementary themes highlighting the most critical processes supporting the customer value proposition.
- Strategic alignment determines the value and role of intangible assets, which includes human, information and organization (learning and growth perspective).

2.2 Schemata Chosen.

For integration, the schemata chosen are the ones of Strategy Maps and Balanced Scorecards Meta-model (SMBSC) [13,14] and the Value Configuration [15] because in terms of relevance, completeness and reliability they are complete conceptualizations of business strategy formulations validated through correct instantiations of the meta-models as well as through their ontological formalization capable to instantiate each business strategy formulation.

2.3 Select schemata' representation.

Both business strategy formulations are conceptualized and represented as UML conceptual models accompanied with constraints expressed in statements [13,14, 15]. UML is accepted as de-facto standard for conceptualizations of models and meta-models.

2.4 Select integration process strategy.

There are four possible variations grouped into *binary*, for integrating two schemata at a time, and *n-ary*, for integrating *n* schemata at a time. Binary strategies can be divided into *ladder*, when two schemata are integrated and another schema is integrated with the intermediate result, and *balanced* when schemata are divided into pairs and integrated symmetrically. N-ary strategies can be divided into *one-shot*, when integration takes place in one step, and *iterative*, when integration takes place in

several steps. For UBSMM a binary, ladder integration process is adapted aiming at progressive and gradual unification of business strategy formulations.

Assigning preferences is relevant mostly in n-ary integration strategies. However, for binary integration strategies is it efficient to consider preferences before choosing component schemata. For UBSMM, there are two pragmatic reasons why VC and SMBSC were preferred; a) to the best of the authors' knowledge no other business strategy formulations have been formalized, thus not available, and b) based on citations and literature search these two are well established in Strategic Management literature [16].

Additionally, given the overall intention for unification of business strategy formulations, according to [4] integration should occur only when complete, correct, minimal and unambiguous representations exist, such as the VC, and the SMBSC meta-models [13,14, 15].

3 Schema comparison

During this second phase schemata are analyzed for correspondences to be identified, and compared for conflicts and inter-schema properties to be identified, as well as to collect other relevant information.

3.1 Analyze schemata for correspondences.

The two schemata are annotated with acronyms; for Strategy Maps and Balanced Scorecards, *SMBSC* is used as a prefix, while for the Value Configuration, *VC*. Classes are presented in the form of schema.class, attributes are presented in the form of schema.class.attribute, and associations are presented as they appear in the schemata capitalized accordingly, e.g. *BelongsTo*.

1. *VC.Strategy* corresponds to *SMBSC.Strategy Map*; both classes refer to an instance of the meta-model, which captures the overall strategy of an organization/unit/actor, etc.
    a. *VC.Strategy.Goal* corresponds to *SMBSC.Goal* that *BelongsTo SMBSC.Perspective.Financial* which is a specialization of *SMBSC.Group*; in VC the long term return on investment constitutes the strategy's overarching goal corresponds to the SMBSC's long term shareholder value which is refined into more supporting financial goals.
    b. *VC.Strategy.Type* corresponds to *SMBSC.CustomerValueProposition* which is a specialization of *SMBSC.Group*; the three generic strategies captured in the type attribute (Cost Leadership, Differentiation, Focus) correspond to SMBSC's four Customer Value Proposition kinds within the Customer Perspective (Low Total Cost,

Product Leadership, Complete Customer Solution, System Lock-In).

2. *VC.Theme* corresponds to *SMBSC.Theme;* in VC it captures a cross functional grouping of value activities embodying an actor's strengths, rooted in the actor's strategy type and value proposition while in SMBSC it constitutes a specific set of interrelated goals of significant interest identifying critical processes important for the customer value proposition.
3. *VC.Actor* does not correspond to any SMBSC construct; the notion of an actor is implicit in SMBSC and can be used as is by referring to the actor for whom the strategy is being modeled.
    a. *VC.Actor.Main* does not correspond to any SMBSC construct; it could also be used as it indicates the actor for whom the Strategy is being modeled. If the actor has at least 1 strategy, which means it's the actor whose strategy is modeled, then TRUE if the actor has 0 strategy, which means it's an actor providing some activity, then FALSE.
4. *VC.ValueProposition,* captures how the actor delivers unique value in a particular set of uses or for a particular set of customers, carries a description attribute, and consists of the aggregation of *VC.PriceRange*, *VC.NeedType*, and *VC.CustomerType,* corresponds implicitly to *SMBSC.Goal* that *BelongsTo SMBSC.CustomerValueProposition* which *IsSubGroup* of *SMBSC.Perspective.Customer* and both are specializations of *SMBSC.Group*; price range captures price relevant information (e.g. should the provision of services be charged? how should costs be recovered? etc.), need type captures need related information (e.g. what particular varieties of service should be provided? etc.), and customer type captures customer related information (e.g. what types of customers should be served? what channels should be used to reach these customers? etc.). They altogether constitute the value proposition in VC corresponding to the goals set on product/service attributes (price, quality, availability, selection, functionality), relationship (service, partnership) and image (brand) that constitute the customer value proposition in SMBSC.
5. *VC.ValueConfiguration* does not correspond to any SMBSC construct;
    a. *VC.ValueConfiguration.Type* does not correspond to any SMBSC construct; however, conceptually there is some correspondence to *SMBSC.Processes*. The value configuration type points to three types of value activity setups which

constitute of a predefined set of activities, and similarly in SMBSC Processes include a predefined set of processes grouped into four categories.

b. VC.ValueConfiguration.Fit does not correspond to any SMBSC construct; captures how value activities within a value configuration are combined, the attribute can have the following values:

- Order 1; first order fit, where there is simple consistency between the each value activity of the value configuration and the strategy (focusing on the value proposition [17, p50 caption of figure 2.4]),
- Order 2; second order fit, where activities are reinforcing,
- Order 3; third order of fit, where there is optimization of effort (eliminate redundancy and minimize the wasted effort). However, in [17] there is a discussion about coordination of the strategic initiatives in order not to hinder each other and benefit from each, eg. share resources etc.... a notion similar to fit.

c. *VC.ValueConfiguration.Margin* does not correspond to any SMBSC construct; "the difference between total value, which is the amount buyers are willing to pay for what a firm provides them, and the collective cost of performing value activities" [19].

6. *VC.ValueActivity* corresponds implicitly *SMBSC.Initiative*;
   a. *VC.ValueActivity.Cost* corresponds to SMBSC.Intitiative.Budget which captures budgetary values (e.g. typically time and money).
   b. *VC.ValueActivity.Value* does not correspond to any SMBSC construct; explanation of how the activity adds value.
   c. *VC.ValueActivity.FitToStrategy* does not correspond to any SMBSC construct; assessment whether the value activity fits the strategy (NOTE relevant for first order fit of the value configuration).
7. *VC.ValueActivityUsage* does not correspond to any SMBSC construct;
8. *VC.ValueActivityType* does not correspond to any SMBSC construct; however conceptually it could be related to *SMBSC.Group* because using the *SubTypeOf* and *SuperTypeOf* self association captures all the different kinds of types of

activities grouped accordingly (through constraints to specific value configurations).

9. *VC. SupportActivity* does not correspond to any SMBSC construct;
10. VC. PrimaryActivity does not correspond to any SMBSC construct;
11. *VC. ValueChainPrimary* does not correspond to any SMBSC construct;
12. *VC.ValueShopPrimary* does not correspond to any SMBSC construct;
13. *VC.ValueNetworkPrimary* does not correspond to any SMBSC construct;
14. *VC.Driver* does not correspond to any SMBSC construct; it captures parameters influencing cost and value in a value configuration. This class carries one attribute; description, and includes 10 generalizations; scale, capacity, utilization, linkages, interrelationships, vertical integration, location timing, learning, policy decisions and government regulations.
15. *VC.Linkages* does not correspond to any SMBSC construct; however, they "are relationships between the way one value activity is performed and the cost or performance of the other"~\cite{porter1998} and conceptually there are similarities to cause-effect relations between goals as they also capture the effect of one goal to the other. AKA the goal self associations.
16. SMBSC.Goal does not correspond to any VC construct; however, some instances of SMBSC.Goal correspond to different VC constructs as presented above: *SMBSC.Goal* that *BelongsTo SMBSC.CustomerValueProposition* which *IsSubGroup* of *SMBSC.Perspective.Customer* and both are specializations of *SMBSC.Group* corresponds to *VC.ValueProposition, and SMBSC.Goal* that *BelongsTo SMBSC.Processes* which *IsSubGroup* of *SMBSC.Perspective.Internal* and both are specializations of *SMBSC.Group* corresponds to *VC.ValueActivity.*
17. SMBSC.Capital does not correspond to any VC construct;
18. *SMBSC.Measure* does not correspond to any VC construct;
19. *SMBSC.Milestone* does not correspond to any VC construct;
    a. *SMBSC.Milestone.Deadline* does not correspond to any VC construct;
    b. *SMBSC.Milestone.Value* does not correspond to any VC construct;
20. *SMBSC.Target* does not correspond to any VC construct ;

3.2 Compare schemata for conflicts.

Based on the afore-presented correspondences, naming comparison allows for the identification of possible synonyms and homonyms between the two schemata. Synonyms are same concepts represented by different names and, homonyms are different concepts represented by the same name. They are identified by studying the context in which they appear, i.e. their attributes, the related concepts, integrity constraints, subtypes, and super types. It should be noted that the naming convention used to present the correspondences above is not taken into account for naming comparisons because it would exclude homonyms.

Naming comparison; conflicts.

The synonyms found in the correspondences is:

- VC.Class.Description and SMBSC.Class.Name; Class is used to refer to all classes of VC and SMBSC respectively that carry this attribute.
- VC.ValueActivity and SMBSC.Initiative;
    - VCValueActivity captures the distinct activities used in a value configuration
    - SMBSC.Initiative encompasses all actions/ activities identified as required towards the achievement of an objective.

The homonyms found in the correspondences are:

- *VC.Strategy* and *SMBSC.Strategy Map*; both classes refer to an instance of the meta-model, which captures the overall strategy of an organization/unit/actor, etc, however they have different constraints. They are
    - *VC.*Strategy captures the desired strategic positioning of the actor.
    - *SMBSC.StrategyMap* refers to the whole strategy map representing a strategy for the future of the company.
- *VC.Theme* and *SMBSC.Theme*;
    - *VC.Theme* captures a cross functional grouping of value activities embodying an actor's strengths, rooted in the actor's strategy type and value proposition.
    - *SMBSC.Theme* constitutes a specific set of interrelated goals of significant interest allowing executives to identify critical processes important for the customer value proposition.
- VC.ValueActivity.Cost and SMBSC.Intitiative.Budget which capture budgetary values (e.g. typically time and money).
    - VC.ValueActivity.Cost captures some numeric estimate
    - SMBSC.Initiative.Budget captures budgetary values in time or money.
- VC.ValueActivity.Value and SMBS.Milestone.Value;
    - VC.ValueActivity.Value captures how the activity adds value to the value configuration.

- SMBSC.Milestone.Value captures the aimed outcome need to be achieved and is relevant to the measure chosen for a particular objective.

- *VC.ValueProposition* and *SMBSC.CustomerValueProposition*
  - VC.ValueProposition captures how the actor delivers unique value in a particular set of uses or for a particular set of customers, carries a description attribute and is associated through aggregation with the classes: Price Range, Need Type and Customer Type.
  - SMBSC.CustomerValueProposition captures four options for defining the customer value proposition in SMBSC based on customer product/service attributes (price, quality, availability, selection, functionality), relationship (service, partnership) and image (brand).

Structural comparison; conflicts.

Based on the afore-presented correspondences, the same real aspect is modeled differently in the two schemata, i.e. using different constructs and/or constraints, resulting into type conflicts, dependency conflicts, and behavioral conflicts (Batini also talks about key conflicts but this is relevant to database schemas). *Type* conflicts exist when the same concept is modeled by different constructs in different schemata. *Dependency* conflicts exist concepts are related with different dependencies in different schemata. *Behavioral* conflicts exist when different constraints are associated with the same constructs in distinct schemata. No dependency or behavioral conflicts have been discovered but a Type conflict:

- VC.Strategy.Goal and SMBSC.Goal;
  - VC.Strategy.Goal is an attribute of *VC.Strategy* capturing the superior long-term return on investment generating real economic value.
  - *SMBSC.Goal* captures all goals set across all four perspectives of SMBSC interrelated through causality relations.

3.3 Discover inter-schema properties.

An inter-schema property is a semantic relationship holding between a set of objects in one schema and a different set of objects in another schema. It is a formula expressed in the union of languages belonging to the two meta-models. A concept in one meta-model that is a subtype of a concept in another meta-model is an example of inter meta-model property.; or an attribute in one mm which is derivable from a set of attributes in another mm.

1. *VC.Strategy.Type* captures the three generic strategies: Cost Leadership, Differentiation, and Focus which reflects the aggregates of VC.ValueProposition (Price, Need, and Customer). This is captured in *SMBSC.CustomerValueProposition* which is a specialization of *SMBSC.Group* and corresponds to SMBSC's

four Customer Value Proposition types within the Customer Perspective (Low Total Cost, Product Leadership, Complete Customer Solution, System Lock-In).

2. *VC.ValueProposition* captures how the actor delivers unique value in a particular set of uses or for a particular set of customers, carries a description attribute and is associated through aggregation with the classes: Price Range, Need Type and Customer Type. In SMBSC, *SMBSC.CustomerValueProposition* captures four types of customer value proposition in SMBSC which influence the goals set on customer product/service attributes (price, quality, availability, selection, functionality), relationship (service, partnership) and image (brand).
3. VC.ValueConfiguration.Fit captures how value activities within a value configuration are combined (Order 1, Order 2, Order 3). In SMBSC (Kaplan & Norton, mastering the management system, 2008) coordination of the strategic initiatives is acknowledged in order not to hinder each other and benefit from each, eg. share resources etc.... a notion similar to fit.
4. *VC. ValueActivity, VC.ValueActivityUsage and VC.ValueActivityType* with its self associations *SubtypeOf* anf *SupertypeOf* capture the various types of values activities based on the value configuration type. Similarly *SMBC.Group* with generalizations for each perspective and the self associations *IsSubGroupOf* and *HasSubGroupOf* captures each *SMBSC.Goal* for each perspective appropriately for the strategy map, *w*hich consequently is transferred to *SMBSC.Initiative* and an activity setup is set.
5. *VC.Linkages* captures the relationships between the way one value activity is performed and the cost or performance of the other. This setup is captured in SMBSC by the self association of *Influences/IsInfluencedBy* of the *SMBSC.Goal* which consequently is transferred to *SMBSC.Initiative*.

4 Conforming to schemata

This phase of schema integration entails resolving the conflicts identified previously to align schemata for the next phase, merging and restructuring. As such, semantic relationships between concepts involved in conflicts need to be identified; *identical*, *equivalent*, *compatible* and *incompatible* [4].

Concepts are considered *identical* when the same modeling constructs are used across schemata to represent the same concepts. *Equivalence* consists of three types: (i) *behavioral*; when corresponding instantiations of concepts can be queried and retrieved, (ii) *mapping*; when concept instances correspond one to one to each other,

and (iii) *transformational*; when a concept is transformed to preserve equivalence with a correspondent concept. Concepts are *compatible* when they are neither identical nor equivalent and their modeling constructs, design principles and constraints are not contradicting each others. Concepts are *incompatible* when their specification is contracting each others.

4.1 Naming conflicts.

For the synonyms found the semantic relationships is:

- VC.ValueActivity and SMBSC.Initiative; Identical
- VC.Class.Description and SMBSC.Class.Name; Identical

For the homonyms found the semantic relationships are:

- VC.Strategy and SMBSC.Strategy Map; Transformational Equivalence
- VC.Theme and SMBSC.Theme; Tranformational Equivalence
- VC.ValueActivity.Cost and SMBSC.Intitiative.Budget; Tranformational Equivalence
- VC.ValueActivity.Value and SMBS.Milestone.Value; Incompatible
- VC.ValueProposition and SMBSC.CustomerValueProposition; Tranformational Equivalence

4.2 Structural conflicts.

- VC.Strategy.Goal and SMBSC.Goal; *Tranformational Equivalence*

4.3 Resolutions for schemata conformance.

As [1,4] indicate, for each naming conflict renaming solves the conflicts. Therefore, for the synonyms found one of the two names is chosen:

- VC.ValueActivity and SMBSC.Initiative; for SMBSC is renamed into SMBSC.ValueActivity.
- VC.Class.Description and SMBSC.Class.Name; for SMBSC is renamed into SMBSC.Class.Description.

For the homonyms found a new name is introduced:

- VC.Strategy and SMBSC.Strategy Map; become VC.StrategyPlan and SMBSC.StrategyPlan
- VC.Theme and SMBSC.Theme; become VC.StrategicTheme and SMBSC.StrategicTheme
- VC.ValueActivity.Cost and SMBSC.Intitiative.Budget; become VC.ValueActivity.Resources and SMBSC.ValueActivity.Resources

- VC.ValueActivity.Value and SMBS.Milestone.Value; VC.ValueActivity.Value remains as is and SMBSC.Milestone.Value becomes SMBSC.Milestone.Threshold.
- VC.ValueProposition and SMBSC.CustomerValueProposition; become VC.UniqueValueProposition and SMBC.UniqueValueProposition

For the structural conflict found:

- VC.Strategy.Goal and SMBSC.Goal; attribute VC.Strategy.Goal becomes a class with a description attribute. VC.Strategy Includes 1 VC.Goal and VC.Goal BelongsTo 1 VC.Strategy. Such class is a homonym to SMBSC.Goal because they have different constraints. Therefore, it becomes a new common name is required, thus they become VC.StrategicGoal and SMBSC.StrategicGoal.

5 Schema merging and restructuring

The conformed schemata can now be merged and restructured to embed the inter-schema properties identified earlier through transformations.

5.1 Inter-schema properties.

ValueProposition: inter-schema properties 1-2.

The three generic strategy types of VC correspond to the customer value proposition types in SMBSC which includes a forth. Price corresponds to Low Total Cost, Need corresponds to Product Leadership, Customer corresponds to Complete Customer Solution, and System Lock-In is also added. This is captured by a 1-1 association of the class StrategyPlan towards UniqueValueProposition. A StrategyPlan Concerns 1 UniqueValueProposition and a UniqueValueProposition CorrespondsTo 1 StrategyPlan. UniqueValueProposition carries a Type attribute which includes a list of four types of value propositions: LowTotalCost, ProductLeadership, CompleteCustomerSolution, and SystemLock-In. Additionally, PriceRange, NeedType and CustomerType are parts of UniqueValueProposition through aggregation associations. Finally, UniqueValueProposition is also a specialization of Group allowing the representation of StrategicGoals as UniqueValueProposition Goals which IsSubGroupOf Perspective of Type:Customer. Consequently, for SMBSC, this setup also supports representing Goals on customer product/service attributes (price, quality, availability, selection, and functionality), on relationship (service, partnership) and on image (brand) that BelongTo UniqueValueProposition Group which IsSubGroupOf Perspective Group of Type: Customer.

ValueConfiguration.Fit: inter-schema property 3.

No additional concept has been introduced to represent coordination on strategic initiatives. ValueConfiguration.Fit exists as is in ValueConfiguration. However, ValueActivityStrategicCompliance carries a boolean FitToStrategy attribute indicating first order fit to strategy for VC but also optional initiative coordination for SMBSC.

ValueActivity usage and type: inter-schema property 4.

For SMBSC, the use of Group has remained the same representing groupings of Goal for all four perspectives. For VC, *ValueActivity* makes use of Group to categorize activities accordingly. Four new classes have been introduced as specializations of Group:

- *ValueChainPrimary* carrying a Type attribute with a list of five options, the five primary activities of the value chain.
- *ValueShopPrimary* carrying a Type attribute with a list of five options, the five primary activities of the value shop.
- *ValueNetworkPrimary* carrying a Type attribute with a list of three options, the three primary activities of the value network.
- *Support* carrying a Type attribute with a list of four options, the four support activities common to all value configurations.

Linkages: inter-schema property 5.

No additional concept has been introduced as both Linkages for VC and the self-association of *Influences/IsInfluencedBy* of *StrategicGoal* for SMBSC remained unchanged, the former links value activities the latter goals.

5.2 Classes.

- *StrategyPlan*; captures the overall strategy of an actor and carries a *Type* attribute, which indicates the business strategy formulation modeled as a list: *SMBSC*, *VC*. Considering the *StrategyPlan* for ABB is of type *SMBSC* and for the Norwegian Police is of type *VC*.
- *StrategicTheme*; captures a grouping of particular interest within a *StrategyPlan* focusing usually of areas of critical importance for executives. For *SMBSC*, a *StrategicTheme* consists of a set of interrelated Goals which may span across perspectives, and for example may identify a set of critical processes within the internal perspective which are important for differentiating the *UniqueValueProposition*. More than one *StrategicTheme* could be identified within the same strategy map and more than one perspective may 20be included. For ABB, a particular *StrategicTheme* is identified ([20], figure 5) consisting of goals whose causality relationships across all perspectives are numbered. For *VC*, a *StrategicTheme* consists of a set of value activities rooted in the *UniqueValueProposition*. Among the essential value activities included in a value configuration, depending on the value proposition, particular value activities are

more critical than others. The Norwegian Police example does not mention any *StrategicTheme*, however, it could be perceived as a *StrategicTheme* itself as it's a focused part of their *StrategicPlan* for the investigation unit where value is created by solving unique problems.

- *Actor*; captures either the organization/unit/individual defining some strategy or the organization/unit/individual performing some value activity. Those could be the same, but not necessarily (e.g. the actor relevant to the strategy is not the same as the one performed an outsourced to some other actor activity). The class carries the Boolean attribute *Main*: which if true refers to the actor for whom strategy is modeled, whereas if false the actor is different than the actor for whom strategy is modeled and performs at least one value activity.
- *StrategicGoal*; capture the goals set either across the four perspectives for *SMBSC* or the strategy overarching goal set in *VC* (usually: superior long-term return on investment). The causality relationships between *StrategicGoals* are captured through the self-association *Influences*, *IsInfluencedBy*. For ABB ([20] figure 6), the StrategicGoal "our net margin is constantly > 15%" (financial perspective) is influenced by the goal "we offer an innovative service concept" (customer perspective), which in turn is influenced by the StrategicGoals "our systems are easy to project and maintain" and "we have a functioning product management" (both from the internal perspective). The StrategicGoal "systems are easy to project and maintain" is influenced by the StrategicGoal "our employees are competent and motivated" (learning and growth perspective).
    - *Objective*; measurable goals that are used for building BSCs, which suggests that not necessarily all goals are used to build a BSC. For ABB there is no distinction between objectives and goals, therefore, the goals defined can directly be linked to measures in accordance to BSC. For example, the goal "our employees are competent and motivated" includes the measure "average number of jobs to which an employee can be assigned" ([20] Table 1).
- *Group*; captures all groupings included in a *StrategicPlan*. Sub-groups can be introduced into groups thereby structuring the nesting of groups inside other groups into a grouping hierarchy. This is captured through the self-association (IsSubGroupOf, HasSubGroup). An example coming from *SMBSC* refers to the grouping of processes within the internal perspective. There exist groups of operations management processes, customer management processes, innovation processes and regulatory & social processes classes.
    - *Perspective*; captures a particular grouping which *BelongsTo* a *StrategicPlan* of *Type*: *SMBS*, which refers to the four perspectives of the Strategy Map (financial, customer, internal, learning and growth). It carries a *Type* attribute with a list of values: *Financial*, *Customer*, *Internal*, *LearningAndGrowth*. For ABB, StrategicGoals are grouped within a *Perspective* of *Type*:*Financial* which is a *Group*, a *Perspective* of *Type*:*Customer* which is a *Group,* a *Perspective* of *Type*:*Internal* which is a *Group,* and a *Perspective* of *Type*:*LearningAnGrowth* which is a *Group.*

- *UniqueValueProposition*; captures how the actor delivers unique value in a particular set of uses or for a particular set of customers in particular price range as expressed by four generic value propositions of SMBSC (low total cost, product leadership, complete customer solution, and system lock-in). *UniqueValueProposition* captures a particular grouping which *BelongsTo* a *StrategicPlan* of *Type*: *SMBS*, which *IsSubGroupOf* a *Perspective* of *Type*: *Internal* which is a *Group* refers to the groups of processes within the internal perspective of a strategy map. It *IsSubGroupOf Perspective* of *Type*: *Customer* which is a *Group* and carries a *Type* attribute with a list of values: *LowTotalCost, ProductLeadership, CompleteCustomerSolution* and *SystemLock-In.* Additionally*, UniqueValueProposition Corresponds* to exactly 1 *StrategicPlan.* Though for ABB a value proposition is not explicitly mentioned, the goals set within the customer perspective point to product leadership. Therefore, for ABB, *StrategicGoals BelongTo* a *UniqueValueProposition* of *Type*:*Productleadership* which is a *Group*.
    - *CustomerType*; captures customer related information (e.g. what types of customers should be served? what channels should be used to reach these customers? etc.)
    - *NeedType*; captures need related information (e.g. what particular varieties of service should be provided? etc.)
    - *PriceRange*; captures price relevant information (e.g. should the provision of services be charged? how should costs be recovered? etc.)
- *Processes*; captures a particular grouping which *BelongsTo* a *StrategicPlan* of *Type*: *SMBS*, which *IsSubGroupOf* a *Perspective* of *Type*: *Internal* which is a *Group* and it refers to the groups of processes within the internal perspective of a strategy map. It *IsSubGroupOf Perspective* of *Type*: *Internal* which is a *Group* and carries a *Type* attribute with a list of values: *OperationsManagement, CustomerManagement, Innovation, and RegulatoryAndSocial.* Though for ABB a value proposition is not explicitly mentioned, the goals set within the customer perspective point to product leadership. Therefore, for ABB, the *StrategicGoal* "we have a sales network for end customers" *BelongsTo Processes* of *Type*:*CustomerManagement* which is a *Group* and *IsSubGroupOf* a *Perspective* of *Type*:*Internal* which is also a *Group* that *BelongsTo* ABB's *StrategyPlan* which is of *Type*:*StrategyMap*.
- Capital; captures a particular grouping within a *StrategicPlan* of *Type*: *SMBS*, which *IsSubGroupOf* a *Perspective* of *Type*: *LearningAndGrowth* which is a *Group* carries a *Type* attribute with a list of values: *Human*, *Information*, and *Organization*. Capital

refers to the groups of capital within the learning and growth perspective of a strategy map.

- *ValueChainPrimary*; captures the grouping of primary activities of a value chain: Inbound Logistics, Operations, Service, Marketing & Sales, and Outbound Logistics. *ValueChainPrimary* is a *Group* and carries a *Type* attribute with a list of values: *InboundLogistics, Operations, Service, MarketingAndSales,* and *OutboundLogistics. ValueChainPrimary BelongsTo* a *StrategicPlan* of *Type*: *VC*, and *Includes ValueActivity* which *BelongsTo ValueConfiguration* of *Type:Chain.*
- *ValueShopPrimary*; captures the grouping of primary activities of a value shop: problem solving, choice, execution, problem finding & acquisition, control & evaluation. *ValueShopPrimary* is a *Group* and carries a *Type* attribute with a list of values: *Problem Solving, Choice, Execution, ProblemFindingAnd Acquisition, and ControlAndEvaluation. ValueShopPrimary BelongsTo* a *StrategicPlan* of *Type*: *VC*, and *Includes ValueActivity* which *BelongsTo ValueConfiguration* of *Type:Shop.*
- *ValueNetworkPrimary*; captures the grouping of primary activities of a value network: infrastructure operation, service provisioning, and network promotion & contract management. *ValueNetworkPrimary* is a *Group* and carries a *Type* attribute with a list of values: *InfrastructureOperation, ServiceProvisioning, and NetworkPromotionAndContractManagement.*
  ValueNetworkPrimary BelongsTo a *StrategicPlan* of *Type*: *VC*, and *Includes ValueActivity* which *BelongsTo ValueConfiguration* of *Type:Network.*
- *Support*; captures the grouping of activities activities of any value configuration: infrastructure management, human resource management, procurement, technology development. *Support* is a *Group* and carries a *Type* attribute with a list of values: *InfrastructureManagement, HumanResourceManagement, Procurement, TechnologyDevelopment. Support BelongsTo* a *StrategicPlan* of *Type*: *VC*, and *Includes ValueActivity* which *BelongsTo ValueConfiguration* of *Type: Chain, Shop, and Network.*

- *Measure*; captures the means to evaluate the achievement of an *Objective*. For ABB, the goal "our employees are competent and motivated" as an objective, includes the measure "average number of jobs to which an employee can be assigned" ([20] figure 6).
- *Milestone*; captures any short-term or intermediate target needed prior to the final target and carried two attributes: *Deadline* and *Threshold:* desired value for the milestone to be completed.
  - *Target*; is a *Milestone* that captures the final, usually long-term, milestone included for each measure determining whether the objective has been achieved. For ABB, and for the objective "our

employees are competent and motivated" which includes the measure "average number of jobs to which an employee can be assigned", the target is set at the end of the third year to 9. Additionally, two milestones are defined; the first one is set at the end of the first year to 5 and the second is set at the end of the second year to 7 ([20], Table 1).

- *ValueActivity*; captures an activity performed and carries a *Resources* attribute which captures both time and money for an activity. For *SMBSC*, encompasses all actions/activities identified as required towards the achievement of an objective. For *VC*, captures the activities that constitute a value configuration *BelongsTo Group ValueChainPrimary*, *ValueShopPrimary*, *ValueNetworkPrimary* depending on the *Type* of *ValueConfiguration* it *BelongsTo* and *BelongsTo Group Support* if it refers to a support activity for any *Type* of *ValueConfiguration* it *BelongsTo*. For ABB, the activities required for the *Objective* "our employees are competent and motivated" are "encouragement of job rotation" and "development of training programs" while budgetary values are not expressed in monetary values, rather actions expressed in time ([20], Table 3).
- *ValueActivityStrategicCompliance*; captures compliance characteristics of a value activity carrying two attributes: *Value*, an explanation of how the activity brings value, and *FitToStrategy*, a boolean assessment whether the value activity fits the strategy (NOTE relevant for first order fit of the value configuration).
- *ValueConfiguration*; captures the value configuration that implements the strategy, based on the value creation logic: a value chain, transforming inputs into products (e.g. manufacturing, etc.), a value shop, resolving customer problems (e.g. health, education, etc.), a value network, networking customers (e.g. insurance, banks, etc.), and carries three attributes: *Margin*, *Type: ValueChain*, *ValueShop*, *ValueNetwork*, and *Fit*: *Order1*, *Order2*, *Order3*. *Margin* captures "the difference between total value, which is the amount buyers are willing to pay for what a firm provides them, and the collective cost of performing value activities" (Porter 1998). *Fit* captures how value activities within a value configuration are combined, the attribute can have the following values: Order1; first order fit, where there is simple consistency between the each value activity of the value configuration and the strategy (focusing on the value proposition [porter2008, p50 caption of figure 2.4]), Order 2; second order fit, where activities are reinforcing, Order 3; third order of fit, where there is optimization of effort (eliminate redundancy and minimize the wasted effort).
- *Driver*; captures all parameters influencing resources and value in a value configuration thus influencing margin and fit. There exist 10 specializations: scale, capacity, utilization, linkages, interrelationships, vertical integration, location timing, learning, policy decisions and government regulations. Due to space limitations only *Linkages* is shown as they are of significant importance to represent the links between value activities within a *ValueConfiguration*.
    - *Linkages*; capture relationships between the way one value activity is performed and the cost or performance of the other, which justifies the double association.

5.3 Constraints.

A number of constraints have been introduced to capture the permissible instantiations of concepts found in SMBSC template and VC. Constraints were added only if they are compatible with SMBSC and VC applications and instantiations found in the literature (we avoided being too restrictive in the constraints).

- StrategyPlan;
    1. A strategy map includes (exactly) one copy of all four predefined perspectives of the strategy map template.
    2. A strategy map includes at least one goal in each perspective.
    3. A strategy refers to a unique value proposition (1..1) and needs to be reflected in a distinctive value chain (1..1). Strategy is linked 1-1 to Value Configuration & Value Proposition because in p115 porter says: a strategy must enable it to deliver a value proposition (compete delivering unique value), A strategy needs to be reflected in a distinctive value configuration, which must be configured to conduct its activities differently tailored to its unique value proposition. Additioanlly the 1-1 relations also are in line with the value system that porter discusses in p.76-77
       Extended example:
       An instance of StrategyPlan of Type:SMBSC is an instance of SMBSC, while an instance of StrategyPlan of Type:V
- StrategicTheme;
- Actor;
    1. An actor with 0 strategy is not the main actor (main:FALSE) and is instantiated as part of another actor's value configuration for representing value activities not performed by the actor for whom the strategy/value proposition/value configuration is modelled (e.g. outsourced value activity) thus constituting the value configuration modelled part of a value system.
    2. An actor with strategy more than 1 is the main actor (main:TRUE) and it's their strategies/value propositions/value configurations being modelled.
    3. For SMBSC, instances of Actor Perform ValueActivity and Actor Defines StrategyPlan are optional.
    4. There must be at least one instance of Actor of Main: True.
- StrategicGoal;
    1. Every goal included in a theme is also included in the strategy map for which the theme is defined.
    2. For goals in the financial perspective no initiatives are launched because targets capture the results of initiatives from the other perspectives.
    3. A goal belonging to either the Customer Perspective or the Internal perspective may influence another goal, which belongs either on the same perspective or the one above (Top-down:

financial, customer, internal, learning & growth). Whereas a goal belonging to the Learning & Growth perspective can only be influenced by another goal belonging into the same perspective (there exists no perspective below) and similarly, a goal belonging to the financial perspective can only influence a goal belonging in the same perspective (there exists no perspective above).

4. Every goal must influence another goal, except in the financial perspective where a top-goal may exist.
5. A goal classified in a group must belong to the same strategy map in which this group belongs to.
6. A goal belonging to a theme must belong to the same strategy map in which this theme belongs to.

- Objective;

- Group;

1. Groups and sub-groups form a pure tree in each perspective:
    a. Perspectives are not a subgroup of any other group. Perspectives constitute the highest level of grouping;
    b. If a group is not a perspective, then it is included in exactly one higher-level group.
    c. A group is not a sub-group of itself (directly or indirectly)
2. A group of a certain type may only be included in the appropriate type of higher level group (according to the SM template):
    a. Allowed sub-groups of the internal perspective are: Operations management, Customer management, Innovation, Regulatory and social.
    b. Allowed sub-groups of the customer perspective are: Product/service attributes, Relationship, Image.
    c. Allowed sub-groups of the learning and growth perspective: Human Capital, Information Capital, Organization Capital.

- Perspective;
    - For SMBSC it is the highest level of grouping within a strategy map and is related to the group class through generalization. Every strategy map includes the four perspectives, that means includes a group of the type corresponding to each predefined perspective (financial, customer, internal, learning and growth). And all of them can only have sub-groups
    - These sub-groupings are accompanied by a refined set of constraints. For example an instance of CustomerValueProposition can only be a subgroup of

Perspective:Customer, while an instance of the Processes can only be a subgroup of Perspective:Internal, etc.

- UniqueValueProposition;
  1. The Customer Value Proposition class is constrained through the IsSubGroup association of the Group class to be sub group of a group which is a Perspective and particularly of the type Customer, therefore, an instance of CustomerValueProposition can only be a subgroup of Perspective:Customer
  2. the group CustomerValueProposition, through the IsSubGroup association, is a sub group of the group Perspective which is of type Customer. The Customer Value Proposition class is constrained through the IsSubGroup association of the Group class to be sub group of a group which is a Perspective and particularly of the type Customer
     - CustomerType
     - NeedType
     - PriceRange
- Processes;
  1. See UVP, therefore, an instance of the Processes can only be a subgroup of Perspective:Internal,
- Capital; see UVP
- ValueChainPrimary
- ValueShopPrimary
- ValueNetworkPrimary
- Support

- Measure;
  1. A measure can have several milestones but has one target among these.
  2. Measures belonging to objectives of the financial perspective have no initiatives.
- Milestone;
  - Target;
- ValueActivity;
- ValueActivityStrategicCompliance;
- ValueConfiguration;
  1. All value configurations include at least one instance of each type of support activity. Primary activities included in a value configuration of a particular type must be of the appropriate type (e.g. primary activities in a Value Network are all belonging to the class of value network primary activities). A value configuration of a particular type includes at least one primary activity of each relevant type (e.g. a value network includes at least one activity of network promotion, one activity of service provisioning and one of infrastructure operation.

2. A value configuration includes at least one instance of each type of support activity. Infrastructure Management, Human Resources Management, Procurement, Technology Development.
3. Primary activities included in a value configuration of a particular type must be of the appropriate value activity type. For Value Chain, there needs to be at least an instance of each of the following: Inbound Logistics, Operations, Outbound Logistics, Service, Marketing & Sales. For Value Shop, there needs to be at least an instance of each of the following: Problem Solving, Choice, Execution, Problem Finding & Acquisition, Control & Evaluation. For Value Network, there needs to be at least an instance of each of the following: Infrastructure Operation, Service Provisioning, Network Promotion & Contract Management.
4. A value configuration of a particular type includes at least one primary activity of each relevant type (e.g. a value network includes at least one activity of network promotion, one activity of service provisioning and one of infrastructure operation)

- Driver
    - Linkage;
        5. Each SupportActivity is origin of at least one Linkage. Each PrimaryActivity is destination of at least one Linkage whose origin is a SupportActivity. A Linkage links two different instances of value activities.

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