Strategic Analysis in the Realm of Enterprise Modeling – On the Example of Blockchain-Based Initiatives for the Electricity Sector

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Abstract. This paper continues our previous work on modeling support for strategic analysis, by (1) extending a proposed modeling language for strategic analysis (called SAML), among others, with features proposed by business scholars to increase the expressiveness of the analysis, and (2) relating the extended SAML to a language for IT infrastructure analysis (called ITML). Thus, we explicitly contextualize strategic analyses by accounting for the role and impact of IT infrastructure. A scenario in the electricity industry is used to illustrate the analysis proposed.

Keywords: strategic analysis, conceptual modeling, NRGcoin.

1 Introduction

Strategic management, to which strategic analysis belong, can be considered as “a collection of decisions and actions taken by the business management in consultation with all levels within the company to determine the long-term activities of the company” [1, p. 125]. The aim of the actions to be undertaken may be manifold, among others, improvement of the competitive position, or the realization of profit growth. In the era of digital transformation those improvements are often achieved through the application of IT artifacts [2].

In this paper, we focus on a specific area of strategic management, namely strategic formulation [3, 4] and investigate strategic analysis tools and approaches, which can be used to support assessment of, among others, planned (digital) initiatives. In this context, a SWOT analysis (Strength, Weakness, Opportunity and Threat Analysis) is an instrument that is traditionally used [5]. However, although well-established and often used, SWOT is also considered to be vague and oversimplified [5]. As a response, approaches that extend SWOT have been proposed, which, among others, (1) suggest additional organizational aspects on which a SWOT analysis can be conducted [6], such as organizational culture and technologies, or (2) propose to combine a SWOT analysis
with the resource-based view [7]. The conceptual modeling community have also acknowledged the need for better instruments supporting strategic analysis [8], and proposed different approaches, cf. [9, 10]. However, they either do not provide semantically rich concepts, are still in their development phase, and/or fall short when it comes to integration with other perspectives (particularly the IT perspective).

Motivated, on the one hand, by this gap, and on the other hand, by the increasing number of digitalization initiatives, in this paper we introduce an instrument for a model-based strategic analysis that explicitly accounts for IT infrastructures. We follow the design school of strategy, cf. [4], thus, we focus on establishing the fit between the internal capabilities and external possibilities [11]. Since the goal of the proposed modeling method is to allow to rationalize the decision made, we treat IT as a white box and consider the large range of both its internal and external factors. To show the applicability of the proposed approach, we focus on the smart grid domain, being one of the domains heavily affected by digital transformations [12]. Particularly, we focus on the blockchain-based NRGcoin initiative in the energy sector [13].

In this paper, we continue and extend our earlier work in the area of multi-perspective valuation supported by modeling, cf. [14], and deliver a three-fold contribution: (1) we extend a Strategic Analysis Modeling Language (SAML) with additional features as found through a literature analysis. Prominently, the proposed extensions include accounting for additional features as proposed by business scholars, and comparing alternative strategic elements, partly on the basis of a root-cause analysis, partly on the basis of relations to other modeling languages; related to the latter, (2) we introduce a mapping between SAML and a language for expressing IT infrastructures called ITML [44]. Thus, we deepen the relation between two particular modeling languages, compared to the brief description of the different relations within the landscape of six languages in [14]; and (3) benefiting from the performed extensions, we deepen a strategic analysis of the NRGcoin initiative. To extend the relationships between SAML and ITML, and to extend SAML, we follow the method proposed by [15] (see Section 3).

The paper is structured as follows. First a short introduction to the strategic analysis with the main focus assigned to a SWOT analysis, as well as the role of conceptual modeling is provided. Then, we describe the extended SAML and its connections to ITML. Next, the case study is discussed showing the applicability of the proposed approach. The paper concludes with final remarks.

2 Background

Strategic Analysis: A strategic perspective emphasizes the long-term outlook on an organization or a network of organizations. This long-term outlook informs analysis of an initiative to be undertaken, e.g., in terms of the long-term organizational goals being pursued and the influence these have on the value-exchanges taking place [16]. Here, strategic orientation refers to analyzing, for a particular organization, the fit between its external situation and internal characteristics [17]. Such analyses are typically done with traditional business school instruments, prominent ones being the 5 Forces
approach or Value Chain [18], balanced scorecard [19], and SWOT analysis [5]. For the remainder of this paper we focus on SWOT, since (1) SWOT, in part due to its simplicity, is still an often-used approach to support the strategy formulation [5], and (2) its shortcomings – being conceptually vague, a missing relation to organizational aspects other than strategy – make extensions to SWOT necessary.

SWOT [20] can be used to assess qualities internal to an organization in terms of Strengths (S) and Weaknesses (W), and situations external to the organization in terms of Opportunities (O) and Threats (T). Furthermore, SWOT allows one to compare internal qualities to external situation, thus allowing for a so-called strategic fit analysis [5]. A typical SWOT analysis lists favorable and unfavorable internal and external issues in the four quadrants of an analysis table, thus providing a better understanding “how strengths can be leveraged to realize new opportunities and understand how weaknesses can slow progress or magnify organizational threats” [5, p. 1]. Although SWOT is a popular tool, it is considered to be vague and oversimplified [5], as it constitutes merely a list that does not “provide sufficient context for adequate strategy optimization” [5]. In line with these criticisms, authors of [8] state that (1) concepts of strategic analysis approaches are often ill-defined, with “strength” having a colloquial understanding at best, which is especially lamentable given the contingency of this concept [8, p. 47], and that (2) a relation of the strategic approaches to a detailed understanding of other aspects of an organization is often missing, with, e.g., IT infrastructure being treated as a black box [8, p. 48].

To address this oversimplification, business scholar literature combines SWOT analyses with other approaches. For one, [6] adopts the resource-based view (RBV) of the firm to provide a further assessment of the strengths and weaknesses internal to an organization, as identified per SWOT, so as to make a comparison with competitors. For instance, for a given “strength” one can use the RBV to assess its rarity, substitutability, and how easily the strength can be replicated (or imitated) by others. Yet another example is a telescopic observations strategic framework [7], which maps strengths, weaknesses, opportunities, and threats against suggested categories, such as technological advancements, economic considerations, legal, and regulatory requirements. Furthermore, to prioritize SWOT items, SWOT has been extended with (quantitative) methods, among others, Analytic Hierarchy Process (AHP)-SWOT [21], Analytic Network Process (ANP)-SWOT [22] and Importance-Performance Analysis [23].

Conceptual modeling in support of strategic analysis: To address ill-defined concepts, and a lacking relation to other aspects of an organization, conceptual modeling in general, and enterprise modeling in particular, can play an important role. Indeed, modeling techniques exist that support strategic analysis, in terms of, among others, goal-oriented requirements engineering (GORE), and modeling techniques that explicitly incorporate concepts from business scholar literature on strategic analysis. Regarding GORE, there exist a variety of conceptual modeling techniques, such as i* [24], the Goal-oriented Requirements Language (GRL) [25], or GoalML [26], for a recent overview cf. [27]. With their focus on modeling (short/medium/long)-term goals, these techniques form a useful point of departure for strategic analysis and have also been used to that extent, cf. [28]. However, the focus on goals means that these general
GORE techniques – with a few exceptions – are equally applicable to other types of analyses. Thus, in their key concepts they often do not address ideas pertaining to strategic analysis as we find them in the discussed business scholar literature.

Besides these generic techniques, however, there exist also GORE approaches that do explicitly take on board strategic analysis concerns from business literature. In line with the idea of analyzing the strategic fit, i* explicitly recommends to make both an analysis of the goals internal to actors, and an analysis of the interactions between actors [24]. Likewise, in [29] the authors provide an approach to analyze strategic fit by combining a domain-specific modeling language (which includes concepts such as goals, value proposition, activity, process, competence, etc.) with AHP and heat mapping techniques. The Business Intelligence Model (BIM) [9] offers concepts (e.g., goals, situations, influences, and indicators) to support strategic business analysis in terms of, both (1) continuous monitoring of organizational goal fulfillment based on KPIs, and (2) analyzing the strategic fit, particularly in terms of a model-based SWOT analysis [9]. The defined relations allow to reason on relationships between situations, influences, and indicators. Although the BIM approach seems to be a powerful tool, to the best of our knowledge, it is not integrated with other perspectives, i.e., with elements from the action system and the information system of an enterprise. As a consequence, BIM does not allow for more sophisticated analyses and strategy definition. Finally, some interesting initiatives may be observed to model strategic plans or strategic control in the realm of enterprise modeling, e.g., [10, 30], which aim at capturing, e.g., influence or impact of an initiative on an enterprise and its resources. However, those initiatives either are still in the development phase, or do not consider IT as a first-class citizen.

Existing enterprise modeling (EM) approaches, while providing the possibility to express various views on an organization, do not explicitly account for strategic analysis as defined by business scholars, cf. [14]. Yet, approaches exist that focus on the (strategic) analysis of IT infrastructure. For instance, ArchiMate [31] allows for relating IT infrastructure and strategy, in the sense that: (1) its motivation extension [31, p. 80] allows for expressing strategy concepts, as also reflected in the explicit mappings between ArchiMate’s general motivational concepts (e.g., “Goal”) and concepts from the business scholar discourse on strategy (e.g., “Mission”), cf. [32]; (2) ArchiMate provides a rudimentary expression of IT infrastructure elements; and (3) ArchiMate provides the ability to express various relationships between layers [31, p. 107]. However, being a language to express enterprise architecture concepts in general, ArchiMate’s focus is not a strategic analysis of IT infrastructure per se. Therefore, various extensions have been proposed, e.g., [33, 34]. For instance, ArchiMate has been extended to relate business goals to IT projects and their underlying infrastructure [34]. The aim of this was to enable valuation of IT portfolios using ArchiMate together with Bedell’s method, in order to measure the strategic importance of IT infrastructure to organizations’ goals. Nonetheless, the overall method only focuses on analyzing IT portfolios of a single organization. Moreover, while concepts from both IT infrastructure and strategy play a notable role here, the focus is actually placed on quantitative valuations. As such, the particular characteristics of IT infrastructure, and the implication these have for the organizational strategy, are less of
a focus. Similar to ArchiMate, ARIS [35] offers concepts to analyze an organization from both a strategic perspective and an IT infrastructure perspective, which provides the possibility to relate these perspectives. However, while ARIS offers more expressiveness than ArchiMate, as especially visible on the strategic end which combines ARIS’s concepts with a balanced scorecard analysis [35, p. 187], the specific relation between IT and strategic analysis remains under-explored. Finally, in proposing a method for model-driven business-ICT alignment, [16] relates organizations’ strategic perspectives (described in e3forces) to their corresponding IT/IS perspectives. However, the model-driven strategic analysis pertains mostly to the external market level only, whereas we require a focus also on the strategic analysis of internal (IT) resources. Also, the IT infrastructure is mostly depicted in an informal (arrow-and-boxes like) manner, which inhibits its differentiated analysis.

**Strategic analysis of smart grid (SG) initiatives:** The emergence of smart grids is driven by the convergence of information and power delivery technologies [12]. The cornerstone of a smart grid is the ability for intelligent devices (e.g., smart meters), dedicated software, processes, etc., to interact and cooperate via an ICT infrastructure. SG initiatives, as any digitalization initiative, are analyzed using the already mentioned instruments, e.g., by means of a SWOT analysis [36]. There are, nonetheless, domain-specific initiatives that aim to evaluate digitalization initiatives in the SG sector, too. For instance, the Smart Grid Maturity Model (SGMM) assesses smart grid initiatives by focusing on (1) six maturity levels (Level 0 Default to Level 5 Pioneering), and (2) eight domains (logical groupings of SG related characteristics). In a similar vein, [37] provides a method to assess the strategic value of IT in SG initiatives by combining the Smart Grid Architecture Model (SGAM), an enterprise-wide and service-oriented framework to describe SG architectures [38], and the Bedell method, which computes the effectiveness and importance of IT elements [39, 37].

### 3 Modeling Support for Strategic Analysis of IT

Based on the conducted study of business scholar literature and existing work in conceptual modeling, a set of requirements has been identified. Due to space restrictions, we present them clustered into three main postulates.

**Postulate 1:** Integrating strategic analysis concepts with other elements of an enterprise action system and an information system (IS). **Rationale:** [40] suggests that one of the primary misuse of the SWOT tool is not to link it with the other perspectives on an organization. Indeed, to make a rational decision and decide on the strategy to follow, considering aspects of an enterprise action system (business processes, goals, resources etc.) and IS, is important [4, 40]. In the era of digital transformation, especially the latter, i.e., accounting for the IT perspective, becomes crucial [2]. Indeed, if a modeling language is explicitly related to concepts expressing the IT perspective, one may conduct a strategic analysis that is grounded in the actual IT capabilities of an organization.

**Postulate 2:** Provision of well-specified, semantically rich concepts which account for proposed extensions to SWOT-based analysis. **Rationale:** Considering two mostly
criticized aspects, namely vagueness and oversimplification of concepts used during the analysis process (cf. Section 2), a modeling method supporting a strategic analysis should provide a rich set of domain-specific concepts with a rich set of attributes that one could use during the analysis process. Here, the proposed extensions to SWOT, such as, e.g., the telescopic observations strategic framework [7] could be accounted for. It should be also possible to assign different weights and different probabilities to different situations in order to mark their importance, cf. [23], as well as to input a justification for the assigned classification (e.g., why we consider something as a strength). When it comes to the classification of a given situation, the modeling approach should enable the classification of some situation in some context differently to account for the fact that “external (or internal) factors of an organization are not always opportunity (strength) or threat (weakness); in other words, in different conditions, they have different meanings” [41].

**Postulate 3:** Accounting for a rich set of relationships, as proposed in the literature.  
**Rationale:** a SWOT analysis leads to the creation of a table of SWOT items, cf. [5]. As such, it does not account for the complexity of the phenomena and resulting consequences. Indeed, if instead of a table we use a diagram, we are able to represent a network of concepts connected using different relationships. This allows to conduct a more sophisticated analysis. Among others, SWOT is often criticized for providing “no indication of causality among the strengths and weaknesses, nor are they ranked into any hierarchy” [42, p. 5677]. As a response, the said set of relationships should allow to account for causality relations among all SWOT concepts (e.g., cause, effect) as well as to account for hierarchies of different states.

**Language design:** As we are interested in the integrated view on an enterprise, making a strategic analysis modeling language part of one of the existing enterprise modeling approaches seems to be reasonable. Based on the postulates, we need a language architecture that would, among others, (1) support the definition of semantically rich concepts, i.e., it should allow for expressing attributes and constraints; and (2) account for various aspects of organizational action system and information system. The MEMO family of languages [43], which we already extended in our previous work, cf. [14], has a language architecture fulfilling the stated postulates¹, and accounts for various perspectives on an organization. Therefore, we continue our previous work with MEMO and use the MEMO Meta Modeling Language (MML) [15] to make necessary extensions.

Fig. 1 (the upper part) shows the key concepts of the extended Strategic Analysis Modeling Language (SAML) [14] and their connections to concepts from other MEMO languages such as GoalML (goal modeling) or OrgML (organization structure modeling) [43]. The initial version of SAML has been extended with additional concepts, properties, relationships and constraints, as indicated in Fig. 1. In terms of the employed language design method [15], it is notable that (1) we consider the purposes and use scenarios as first-class citizens that drive the design of the language landscape, (2) we employ the guidelines for concept inclusion from [15]. For example, the concept **involvementContext** (see Fig. 1) and its various attributes and relations conform to both

¹ For an elaborate discussion on the selection of the approach to be extended, see [14].
the guideline “relevance”, in terms of relevance to various analysis scenarios, and “invariant semantics”, in the sense of its semantics being invariant over different analysis scenarios, as well as the concept having its own essential characteristics. Note that, due to space constraints, we unfortunately cannot further elaborate on the used language design method.

Figure 1. SAML and exemplary relations to the extended ITML.

The main concept for analysis is a **Situation**, which, in line with BIM, is defined as a partial state of the world that has a structure consisting of relations and elements. In line with the presented postulates, a **Situation** has a rich set of attributes allowing to describe which state we mean, what is its probability, as well as, e.g., its classification.
(e.g., whether it is internal or external [4, 1]). For all concepts, in line with Postulate 2, the level of justification, scope, or importance can be defined. *Situations* may be linked to other *Situations* by relationships: (1) *is_alternative_to*, which allows us to model SWOTs arising from different alternatives in the same diagram. This is opposed to a typical SWOT analysis, whereby one has to draw a separate table for each alternative, which also makes it difficult to compare individual SWOT elements to each other; and (2) *occurs_in_parallel_with*, which allows us to cluster situations according to a logical grouping; and (3) *CausalRelation*, which allows to account for the fact that situations are not independent, cf. [42]. Here, to streamline the analysis, we differentiate in the concrete syntax between two types of relationships considering the probability of occurrence (cf. attribute *occurrenceCertain*): *results_in* and *may_lead_to*. Next, to aggregate situations into a more abstract situation, situations can be modeled as a hierarchy using the relation *is_part_of*. Finally, to account for the fact that depending on the context the same situation can be differently classified, we introduce *SituationInfluence* as an Association Class with a set of relevant attributes.

Furthermore, we include explicit relationships to elements of an IT infrastructure (i.e., to ITML [44]), such as *impacts*, *involved_in*, which allow us to identify the role and the type of influence of the IT infrastructure on possible situations. To increase the semantics of those relationships, we benefit from the already mentioned resource-based-view and characterize those relationships with an additional set of attributes such as: (1) evaluation of the IT as resource as valuable, rare, imperfectly imitable, or non-substitutable; as well as (2) assessing the certainty of an evaluation and its justification. In addition, it is possible to assign a role to an IT artifact in a given situation. Here, we differentiate the role by referring to classifications that point out the role of information systems in innovation processes (e.g., as an enabler or capability, cf. [2]).

To ensure that the created models are consistent with the underlying language specification, we extend the corresponding tool for modeling with MEMO, called MEMO4ADO [45]. Finally, MEMO4ADO is used to model the NRGcoin scenario.

4 Illustration: Strategic Analysis of the NRGcoin Initiative

NRGcoin defines a blockchain-based support policy for renewable energy sources that aims to reward production and consumption of renewable energy [13]. The locally produced electricity is directly fed into the grid and withdrawn by consumers and prosumers. The electricity injected by prosumers is rewarded with NRGcoins, based on the amount of demand within a district the injection helps match. If the injected electricity does not match any demand, it is not rewarded, which encourages prosumers to consume their own electricity [13]. NRGcoins are rewarded to prosumers every 15 minutes, once smart meters inform the distribution system operator (DSO) about the amount of electricity being injected and withdrawn [13]. Thus, during the execution of the NRGcoin initiative, three types of transactions take place: (1) electricity consumption and injection transactions that record the amount of electricity being withdrawn/injected; (2) NRGcoin payment transactions that record: the number of NRGcoins being paid to the DSO for using the electricity grid infrastructure, the
number of NRGcoins rewarded to prosumers for their injections, and the number of NRGcoins charged to consumers for their consumption; (3) NRGcoins trading transactions that record how NRGcoins are exchanged in the coin market against fiat currencies.

A tamper-proof ledger, as the one offered by a blockchain, serves as a promising mechanism to record these three types of transactions. Blockchain ledgers are distributed among the nodes that participate in the network. Transactions are organized in blocks that are chained up into blockchains. Every node in the network has access to the whole history of the transactions, and can check the validity of the blocks and transactions. Lacking a central authority to keep track of, validate, and write new records in such a distributed ledger, blockchain-based solutions make use of “consensus mechanisms” to reach agreement among nodes on who will (1) validate the transactions, (2) create the next block, and (3) broadcast it to the rest of the network [46].

In our previous work [14], we have demonstrated the advantages of NRGcoin initiative in achieving the following goals of stakeholders: (1) the share of green energy consumption is increased as consumers can purchase green energy at a fixed rate of NRGcoin; (2) self-consumption is promoted for prosumers because injection that does not match local demand will not be rewarded; (3) stress on DSO grids is relieved because local demand is met by local supply, and extra supply is self-consumed by prosumers, hence, there is less energy that needs to be transferred further up to the grid; (4) utilities’ operational costs are reduced as most of the daily operations are automated with the help of smart contracts; and last but not least, (5) no dedicated budget from the government is needed because incentives to both green energy consumption and green energy production come from NRGcoin itself. In this paper, we address the problem of deciding which consensus protocol should be used to create the blocks in the NRGcoin ledger: Proof of Work (PoW) or Proof of Stake (PoS), cf. Fig. 2.

PoW is a pure cryptography consensus mechanism whereby so-called miners interested in becoming the creator of the next block compete to solve a cryptographic puzzle [46]. The first miner that finds the correct solution to the puzzle will become the creator of the next block. This miner will be rewarded with new coins (referred to as mined coins) and earns also fees associated with the validated transactions. In turn in PoS, blocks are said to be “forged” or “minted” instead of “mined”. Candidates for the creator of the next block are referred to as validators. The probability for a validator to become actually the creator of the next block is in proportion to the amount of coins the validator owns. The selected validator earns fees associated with the validated transactions. Since the PoS technique is prone to security issues due to its simplicity [47, 48], various socio-economic counter-measures have been introduced. E.g., validators can be requested to lock a certain amount of coins as a stake in a security deposit in order to become a candidate for the next block. If the selected validator conducts malicious behavior while validating the next block, this validator will be punished by losing the stake (economical measure). A similar punishment measure can also be put in place from the social point of view, whereby the selected validator is required to sign the block she/he creates. If a peer node detects faults in the block and reports it to the network, the validator will be punished with bad reputation and will be
forbidden to participate in future validations. In an extreme case, the node can even be expelled from the network.

Figure 2. Overview on IT Infrastructure of Alternative Consensus Mechanisms

The decision on the used consensus protocol (PoS versus PoW) is important, as the protocols exhibit differing characteristics, which directly or indirectly impact the defined goals. We elicit and compare these characteristics by means of a SAML diagram for strategic analysis in combination with an ITML diagram for IT infrastructure analysis. Note that we focus only on those parts of the analysis that illustrate the added value of our approach, i.e.: (1) comparing alternative situations; (2) allowing to analyze how situations form a SWOT for achieving goals; and (3) enabling analysis on how situations relate to each other in terms of a root-cause analysis.

First of all, being a renewable energy initiative itself, NRGcoin’s main goal is to promote energy efficient solutions (G1) as well as to promote production and consumption of renewable energy (G2). NRGcoin users are consumers and prosumers at the lower end of the electricity grid with the aim to set up a local energy community among them (G3) that calls for social responsibilities (G4). Achievement of the aforementioned goals can be examined from various perspectives. In the following, we
show how the respective IT infrastructures underlying the PoW and PoS protocols (depicted in Fig. 2a and Fig. 2b respectively) contribute to the fulfillment of the goals of the NRGcoin initiative.

Looking at Fig. 3, we notice that the distinct features of PoW and PoS lead to two alternative situations being the roots for two chains of situations connected via causal relations differentiated into “results in” or “may lead to”, as explained in the previous section. Looking at the left side, among others, the mining application of PoW is simple, but very heavyweight, as the simple logic of PoW needs to be repeated several times until a hash code satisfying the condition can be found. As a consequence, mining takes on average long to finish, hence it likely causes delay to the validation of transactions (G5). In contrast, concerning time consumption, we find that PoS provides timely validation. In the diagram this is indicated by the situation “timely validation, little to no delays”, which subsequently, among others, traces back to a function topic “sign forged blocks” (an IT infrastructure element). Importantly, this tracing is done via an annotated SAML-ITML relation that (in line with the resource-based view of the firm, cf. the meta model in Section 3) is, both (1) “valuable”, with the justification that for PoS the signing of forged blocks happens in a short time compared to mining in PoW, and (2) “rare”, with PoS being novel and thus, not yet widely adopted. Moreover, due to its heavy weight, mining consumes a significant amount of electricity, which makes PoW a less energy efficient solution (G1). In our models, we first trace this significant electricity consumption to the situation “increased consumption of energy”, which has a relation “Weakness: very high” with goal G1. Subsequently, we trace this situation to the function topic “Solve the hash puzzle”, whose specific properties and underlying IT infrastructure we can further examine with the help of the corresponding IT infrastructure diagram (Fig. 2). More specifically, in the IT infrastructure diagram we find that the function topic “Solving the hash puzzle” is provided as a functionality of a “Mining App”, and that this functionTopic has the attribute “resourceUsage=high”. Furthermore, the resource use is also reflected in the underlying hardware required to run the mining application which often runs on dedicated, resource-intensive hardware (cf. Fig. 2a).

Considering that the validation is a time-consuming task, the management of the NRGcoin ledger may be outsourced to a set of miners, as indicated by the relation “may lead to”. This situation has two implications. Firstly, miners, being outside of the local energy community, have no access to the green energy produced within the community, hence would rather sell all earned NRGcoins than use them to purchase green energy for consumption. Therefore, this situation (being external from the point of view of our initiative) is a threat of PoW with respect to “G2: Promote Production and Consumption of Renewable Energy”. Secondly, miners have no sense of belonging to the community, hence their participation in validating transactions and mining is purely profit-driven. This is a threat towards “G4: Increasing Social Responsibility”.

In contrast to PoW, the PoS algorithm is complex (as it needs to integrate additional functions that implement social and financial counter-measures, Fig. 2b), but lightweight. As PoS is lightweight, validators consume modest amount of electricity to fulfill their tasks, hence PoS is an energy efficient solution (G1). Therefore, common
Figure 3. An excerpt of the Strategic Analysis Diagram of NRGcoin: PoW vs. PoS
PCs, which almost every family is in possession of, suffice to run the light PoS algorithm efficiently. This situation is a strength of PoS, because it allows any member of the NRGcoin community to become a validator. Unlike PoW, PoS validators are the same local participants (prosumers, consumers or DSO) in the green energy community, which can be interconnected by a local-area network (LAN). This has two implications. On the one hand, validators can purchase green energy with the earned NRGcoins. This is a strength of PoS contributing positively to G2. On the other hand, in addition to earn transaction fees, another reason for members of the local community to perform the role of validators is because they feel responsible to maintain the operation of the NRGcoin. This is a strength of PoS with respect to G4.

5 Conclusions

In this paper, we have shown how enterprise modeling can support the strategic analysis of digitalization initiatives by using a combination of two modeling languages: SAML, for expressing strategic analyses, and ITML, for expressing IT infrastructure. Specifically, we showed how (1) SAML allows for explicitly relating strategic elements to each other, allowing for root cause analyses, and how (2) the explicit relation of SAML to ITML can be used to contextualize elements of a strategic analysis.

In terms of limitations, firstly, we notice that the produced SAML models become complex quickly. While this complexity is not a novel phenomenon (goal models tend to have a similar issue), it should be addressed since it makes the models hard to interpret, thus potentially inhibiting the added analysis capabilities started with. Secondly, in this paper we focused on modeling languages to support mainly strategic analysis of IT infrastructures. Therefore, additional extensions are required to support the strategic formulation phase in its entirety. A method to support such a model-driven analysis is also part of our future work.

References


