Exploring Intentional Modeling and Analysis for Enterprise Architecture

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***Abstract*— An enterprise architecture is intended to be a comprehensive blueprint describing the key components and relationships for an enterprise from strategies to business processes to information systems and technologies. Enterprise architectures have become essential for managing change in complex organizations. While "motivation" has been recognized since Zachman [1] as an important element of enterprise architecture, yet to date, most enterprise architecture modeling only deals with structure, function, and behaviour, neglecting the intentional dimension of motivations, rationales, and goals. The contribution at hand explores this challenge and aims to illustrate the potentials of intentional modeling in the context of enterprise architecture. After introducing two intentional modeling languages and their potential relation to an enterprise architecture construction process, we report on an explorative case study that aimed to investigate the practical implications of intentional modeling and analysis for enterprise architectures. Finally, we present key observations from interviews that were conducted with practitioners to obtain feedback regarding the material developed in the case study.**

***Index Terms*—enterprise architecture, intentional modeling, agent-oriented modeling**

I. MOTIVATION

Organizations today are increasingly adopting enterprise architecture frameworks (such as the Zachman Framework [1], TOGAF [2], IAF [3], FEAF [4], DoDAF [5]) to cope with complexity and constant change. Systematic, enterprise-wide approaches are expected to help increase business agility, strengthen accountability, and improve organizational performance and competitiveness. Many governments, for example, have found such frameworks to be invaluable when re-architecting the multitude of information systems needed to provide an evolving array of services. In some cases, the adoption of an enterprise architecture approach is even mandated by law (such as the Cohen - Clinger Act of 1996 in the United States).

Enterprise architecture (EA) relies heavily on conceptual modeling languages. Modeling and analysis of enterprise architectures encompasses strategic, process and application dimensions [6], covers structural and behavioural aspects [7], and includes, for example, business visions, activities and entities, information structures and operations, functions, events and processes. While well-established modeling methods based on ER[1], DFD[2], and UML[3] are extensively employed in enterprise architecture, more recent developments in conceptual modeling have not yet been exploited.

Although motivation has been recognized as an important aspect of enterprise architecture since Zachman [1] (column 6 in the 6-by-5 matrix of cells), most enterprise architecture modeling focuses only on structure and behaviour, neglecting the intentional dimension (or "why" dimension of enterprise knowledge [8]). For example, current EA practice uses conceptual models to express as-is and to-be architectures, while the *reasons behind the choices* of to-be architectures, and the *exploration of alternatives* are recorded *outside the models*, if documented at all. The reasoning behind EA construction is therefore hard to trace and hard to challenge, and responding to change is difficult. The overall research objective of this work is an assessment of the potentials of intentional modeling languages, such as BMM [9] and i* [10], in the context of enterprise architectures, to gauge the prospects and challenges of incorporating intentional modeling concepts into EA practice. Consequently, this contribution first introduces two intentional modeling languages and explores their potential benefits and pitfalls in the context of enterprise architectures. Then, intentional modeling concepts are related to different steps of an enterprise architecture construction process. Subsequently, we develop a series of intentional models for enterprise architecture in a health care case study to explore practical implications of intentional modeling concepts in the context of EA. To obtain insights into the practical value of these investigations, the results are discussed with enterprise architecture practitioners familiar with the health claims case. We conclude our contribution with a discussion of our work and an outlook regarding future research.

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[1] ER…Entity Relationship
[2] DFD…Data Flow Diagrams
[3] UML…Unified Modeling Language

II. Intentionality AND Enterprise Architecture

Enterprise architecture frameworks typically classify and organize the types of knowledge needed to describe and analyze the business and IT architectures for the enterprise. The Zachman framework [1] defines a matrix of five rows – scope, business model, system model, technology model, detailed representations – and six columns – data (what), function (how), network (where), people (who), time (when), and motivation (why). Each cell in the matrix identifies a class of EA artefact objects. Many other frameworks have since refined or elaborated on these perspectives and aspects. Notably, the "why" aspect has not received much attention, and is seldom supported by modeling. One explanation could be that modeling languages that support the "why" aspects have not been widely available.

Nevertheless, understanding the motivation and intentions of stakeholders is critical for architectural decisions and actions. "*If an enterprise prescribes a certain approach for its business activity, it ought to be able to say why*" ([9], page 14). Since the modeling of "why" knowledge is poorly supported by current frameworks, they are typically embedded in documents, meeting minutes, or held in the minds of individuals involved. Intentional knowledge is therefore often *implicit*, *hard to get at*, *not systematically managed*, and *easily lost*.

Explicitly modeling the intentions of different stakeholders in enterprise architectures can be expected to benefit organizations in different ways: Firstly, the goals of organizational actors would be made explicit, thereby *increasing transparency* about the drivers behind business transformation. Secondly, by making the distributed intentions of these stakeholders transparent, a *foundation for the systematic analysis* of design implications can be laid. Thirdly: By analyzing the different goals, decisions for selecting specific enterprise architectures over a set of alternatives can be made in a *rational way*. Fourthly: By relating the goals to specific architectures, the context and necessity of transformation activities becomes *documented* and can be *traced back* when, for example, justifying past actions or revisiting decisions.

As a consequence, we not only aim to *enrich traditional model artifacts* in this contribution, but more importantly we suggest reconsidering the *process of model construction* itself. In detail, this paper aims to demonstrate that

- the **"why" knowledge** (motivation, goals) behind enterprise architecture **can be organized** through the application of intentional modeling concepts in a systematic way
- the **"why" can be linked to the "how"** – motivations and goals can be linked to non-intentional elements such as processes and tasks appearing in conventional EA models
- **new kinds of analysis** can be done – for example, to determine whether goals are achieved - to guide exploration of alternatives during EA construction that will address different stakeholders' goals.

III. Intentional Modeling Languages

Recent developments in conceptual modeling have gone beyond the treatment of static and dynamic ontologies to cover intentional and social ontologies [10]. These new developments have influenced requirements engineering [11], in the form of goal-oriented and agent-oriented [12] approaches. Intentional modeling plays a prominent role in, for example, the NFR Framework [13], where goals are used to structure and deal with non-functional requirements (NFRs). In KAOS [14], (functional) system requirements are derived from goals. For the purpose of illustrating the capabilities of intentional modeling to enterprise architectures, we introduce and discuss two intentional modeling languages in greater detail here – the Business Motivation Model (BMM) and i*, that provide different levels of scope and detail with respect to intentional modeling.

The **BMM** [9] focuses on modeling intentionality by providing a scheme for developing, communicating and managing business plans in an organized manner. It has been proposed as a standard under the Object Management Group (OMG) and provides a meta-model that introduces elements and relationships of intentional modeling. Central elements include *Means*, *Ends*, *Influencer*, *Potential Impact* and *Assessments* that are specialized into more detailed elements such as *Visions*, *Desired Results*, *Goals*, *Objectives*, *Missions*, *Course of Actions*, and *Internal* or *External Influencers*.

The **i* framework** represents an intentional, agent oriented approach to requirements engineering [15]. Modeling elements in i* include, *Goals*, *Softgoals*, *Tasks*, and *Resources* (see Figure 1). They are organized around strategic *Actors*, which can be specialized into *Agents*, *Roles*, and *Positions*. A distinct characteristic of the i* framework is the ability to use the models to determine whether goals can be achieved [15]. Softgoals are goals that have no clear-cut definition and/or criteria as to whether it is satisfied or not. With i* *goal evaluation*, the modeling elements can be assigned *Evaluation Labels* (*satisficed*, *denied*, and others) so that the *viability* or *workability* of higher level goals can be evaluated based on contributions from lower level elements [16]. Such an intentional evaluation mechanism allows for reasoning about intentionality and for exploring solutions and choosing among alternatives.

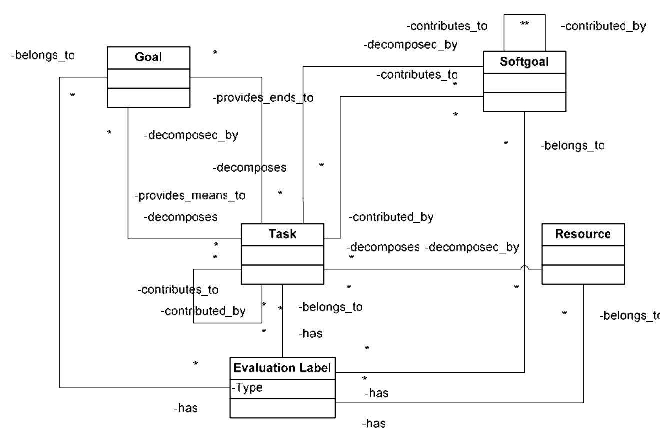

Fig. 1. The i* Meta-Model for Strategic Rationale Models (Simplified) in UML

Two types of models are introduced by i*: *Strategic dependency (SD) models* describe dependency relationships among various actors, while *strategic rationale (SR) models* make the internal rationales of actors explicit. Figure 1 shows a simplified meta-model for SR models - for further details we point to [15]. Concrete instantiations of i* SD and SR models are shown in Figures 4, 5 and 6.

IV. Potentials of Intentional Modeling Concepts in Enterprise Architecture Construction

In this section, we aim to illustrate the potentials of intentional modeling concepts for enterprise architecture, in order to gauge the prospects and challenges of eventual adoption. As such, our approach is *not meant for practical adoption* in its current form. Its purpose is to *showcase and contrast* the applicability of two intentional modeling languages in the context of enterprise architecture. First, we will suggest that BMM can be used to capture high-level business motivations. Then we will propose that i* can be used to further refine the BMMs and to perform analysis making use of the semantics of intentional concepts.

Figure 2, illustrates how the different concepts of the two intentional modeling languages can be related to the *process of enterprise architecture construction*. Relating intentional modeling concepts to the construction process represents a reasonable approach because intentionality already guides, influences and constraints architecture development. *By explicitly incorporating intentionality in the early phases of architecture construction, intentionality can be subject to analysis and revision and thereby can represent a justified basis for making rational architectural decisions during the process.* After discussing the potentials of intentional modeling concepts in the context of enterprise architecture construction, we aim to demonstrate how intentional modeling concepts can be applied in a real world example.

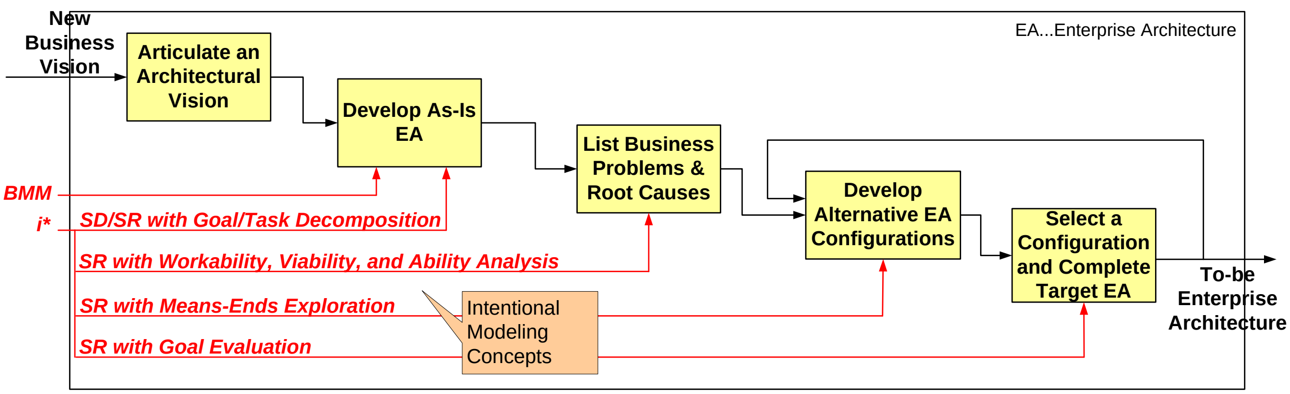

Fig. 2. Potentials of Intentional Modeling Concepts for the Process of Enterprise Architecture Construction

Figure 2 illustrates typical steps of an enterprise architecture construction process (similar to, for example, [2] and [18]), distinguishing five interrelated stages. Our focus is on the *intentional modeling concepts* that can provide support at various stages. These are shown as mechanism inputs (arrows entering from bottom) in the spirit of SADT [19]. In the following, we explain what kinds of intentional modeling concepts can contribute to the typical steps of enterprise architecture construction [20]:

1) Enactment: Articulate an Architectural Vision

The first step in enterprise architecture construction is typically concerned with the articulation of an architectural vision to define the scope, the relevant stakeholders, and the key business requirements of the enterprise architecture project [2]. This is a high level activity that sets the overall context of the project and helps the project team to focus, to develop a common vision and to obtain management commitment. The output of this activity may consist of lists, tables, maps and informal models capturing the architectural vision adequately. Since this step typically represents a highly informal activity, intentional modeling cannot offer significant support at this stage.

2) Selection: Develop As-is Enterprise Architecture

From an intentional perspective, the basic questions in the second step are "*What is the organization doing to achieve its goals? And why is it doing things the way it is doing them?*". To answer these questions, BMM can be used to explicitly express high-level business motivations. BMM captures information about *Means* and *Ends*, *Influencers* and their *Assessments* and *Potential Impacts*. An *Influencer* is something or someone that can cause changes that affect the enterprise in its employment of its *Means* or in the achievement of its *Ends*, and can be as diverse as *a competitor, regulations or company values*. An *Assessment* is a judgment about the influence that an *Influencer* has on the enterprise's ability to employ its *Means* or achieve its *Ends*. These elements can represent the basis for **organizing "why" knowledge** of enterprise architectures. Links in the BMM are bi-directional and thereby provide forward and backward traceability through the model elements and relationships, which can help in answering the two focal questions of this step. The i* strategic dependency model can be related to the Business Motivation Models and can connect business motivations to the intentions and goals of stakeholders thereby **linking the "why" knowledge to the "how"**. In addition, the (high-level) goals and business processes that are referenced in BMMs can be related to each other and further refined in i* strategic rationale models through the concept of i* *Means-Ends modeling* and i* *Goal/Task decomposition* [20]. The i* framework provides conceptual instruments to model and refine this information until a satisfactory degree of detail is achieved.

3) Diagnose: List Business Problems & Root Causes

In this step, the constructed as-is enterprise architectures can be analyzed in the light of the enterprise architecture vision. BMM offers high-level *weakness analysis* to identify for example insufficient achievement of business requirements. i* complements and extends these analysis possibilities by providing more detailed *workability*, *viability* and *ability* analysis. Workability is a first-pass analysis to determine if goals and tasks are achievable, ignoring the quality considerations expressed in softgoals. This can be determined by investigating each sub-branch of the *goal/task decompositions* and judging if they are workable recursively. Un-workable processes represent business problems that need to be addressed in subsequent steps.

In viability analysis ([12], page 230), quality (non-functional) factors such as performance, security, accuracy or interoperability are included. These quality goals, modelled as *Softgoals* in i*, often compete with each other and require tradeoffs. Viability analysis helps to answer questions such as "*What are the softgoals of an organization?, How are they currently operationalized? To what extent are softgoals currently met? And what are the obstacles to fully achieving the softgoals?*" Ability analysis enables investigating the stakeholders' abilities to meet each others' goals. This allows for answering questions such as "*To what extent are stakeholders satisfied? Whose and what dependencies are not sufficiently supported so far?*"

4) Development: Develop Alternative Enterprise Architecture Configurations

This step is concerned with the discovery of architectural alternatives for achieving the identified business goals and problems. Links between *Goals* and *Courses of Actions* in Business Motivation Models can represent a starting point for the structured exploration of alternatives. *Means-ends links* in i* can act as solution generators to produce more concrete alternatives for each point of interest. In addition, the effects of different options on the identified business goals and problems can be explored and analyzed with the i* framework.

5) Selection: Select a Configuration and Complete the Target Enterprise Architecture

In the final step, architectural alternatives are evaluated and the target enterprise architecture is completed. Questions that are typically addressed include "*What architecture works better than others, and why? Do specific architectures sufficiently address the identified goals? Are there better architectural alternatives?*". Considering environmental constraints (such as legacy architectures), not all of the identified alternatives may be workable. In order to answer the questions, BMM and i* can help *rank alternatives* according to their overall contributions to different stakeholders' goals by conducting *goal evaluation* on alternative *to-be architectures.* This kind of evaluation promises to enable **new kinds of analyses** for enterprise architecture that are not available with non-intentional modeling frameworks.

V. A Case Study in the Health Care Domain

The developed vision of incorporating intentional modeling concepts in enterprise architecture construction processes was tested in and applied to a scenario in the health care domain. In a health claims payments context, the BMM and i* model languages were instantiated to identify improvements for the current organization of health claims payments processing. Information for developing the scenario was gathered through consultation with a project manager of an ongoing health claims project, and with leaders overseeing the province-wide adoption of enterprise architectures practices in the Government of Ontario, Canada. Information available publicly on the Ministry of Health and Long Term Care (MOHLTC) website [21], [22] and related health care websites were also used. The case study followed the sequence of typical steps of EA construction processes introduced in the previous section.

The scenario includes a billing system that processes health claims for over 12 million eligible health care clients. The system has evolved over a period of years, and over time it has become more and more complex. Today it is no longer able to meet the diverse interests of many heterogeneous stakeholders. Problems include *incomplete and inconsistent information within the system*, as well as a *high degree of segregation in payment processing* which incur avoidable transaction costs. In the scenario, the health care provider lacks a clear business strategy to leverage technology for business improvement. This was evident in several past attempts that failed to satisfy the involved stakeholders. The *complexity of the domain*, together with its *pressing need for business transformation* represents a promising starting point for applying intentional modeling concepts for the identification of improvements to the enterprise architecture. Based on the available case study documents and interviewing with a project manager in the health care domain, a set of models was constructed.

In the first step **Articulate an Architectural Vision**, the *as-is* business context was identified, including the current *business strategy* as well as all relevant *stakeholders* and their corresponding *motivations and expectations*. Based on that, an *architectural vision* for the *to-be* business context was developed. The result of this activity was a table covering strategies, stakeholders, and motivations for the *as-is* as well as for the desired *to-be* situation. In the second step, **Develop As-Is Enterprise Architecture**, the as-is situation of the health claims payments program was modelled in greater detail, utilizing the intentional modeling language BMM. The output was a series of BMMs that identify the currently pursued *Business Vision* and *Mission* as well as currently implemented *Courses of Action* and their relationships to *Desired Results* and *Directives*.

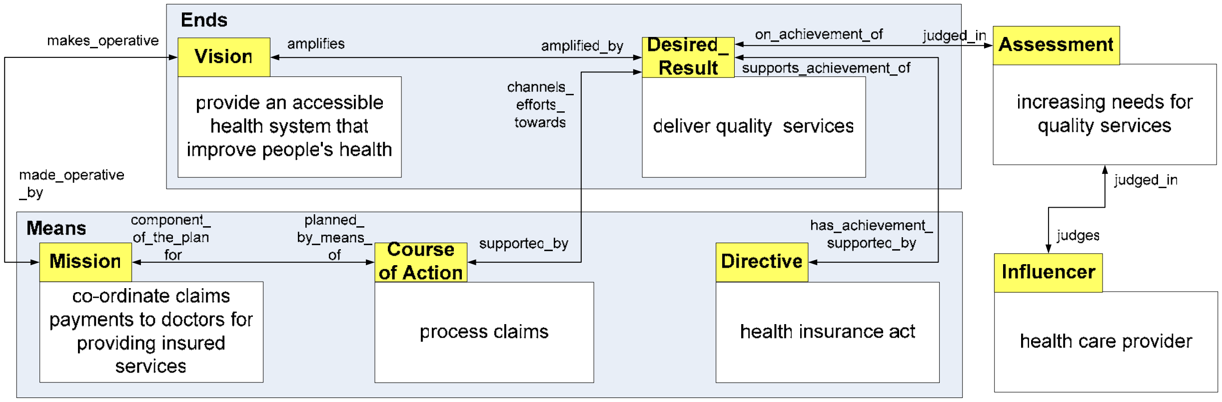

Fig. 3. An Excerpt of Business Motivation Models Developed in the Health Claims Payment Case

Figure 3 shows an excerpt[4] of the developed business motivation models illustrating central relationships between some of the elements. In this figure, the desired outcome of business transformation was framed as the *Desired Result* deliver quality services. The *Desired Result* is supported by the *Directive* health insurance act and by the *Course of Action* process claims. Process claims in turn is a component of the *Mission* coordinate claims payments … that makes the *Vision* provide an accessible health system that improve people's health operative. The business motivation model can be extended with *Assessments* (judged by *Influencers*), and their relationships to *Directives* and *Potential impacts*. This is partly depicted in figure 3 by the *Influencer* health care provider that assesses an increasing need for quality services. BMM models can provide a foundation for analyzing *why goals exist* (by following links between *Desired Results* and *Assessments*) and *how they are currently addressed* (by following links between *Desired Results* and *Courses of Action*), thereby **organizing "why" knowledge**.

Although the developed business motivation models already give an overview of the drivers behind the current business context, they cannot be analyzed in terms of workability or viability and cannot be further refined to concrete business activities. In other words, the models developed so far are not well integrated with traditional enterprise architecture concepts yet. At this point, the i* framework was utilized 1) to *bridge the gap between intentional elements* (such as *goals*, *motivations*) *and traditional elements* (such as *tasks*, *roles*) of enterprise architecture models, thereby **linking the "why" knowledge to the "how"**.

Figure 4 illustrates how the identified elements of BMM were detailed into i* elements. With i*, they could be further refined and related to concrete *Actors*, *Goals*, *Softgoals*, *Tasks* and *Resources*, which represent modeling elements that can (in part) be related to traditional elements of enterprise architecture frameworks. In figure 4, the health care client depends on the health care provider to fullfill the *Goal* of fast treatment and the *Softgoals* insured services be provided and privacy. The claims processing unit depends on the health care client to perform the *task* verify services received in order to provide the health care provider with the *resource* payments. The modeling notation of i* allows to combine these different elements into an integrative enterprise architecture that contains the notion of intentionality as a fundamental part.

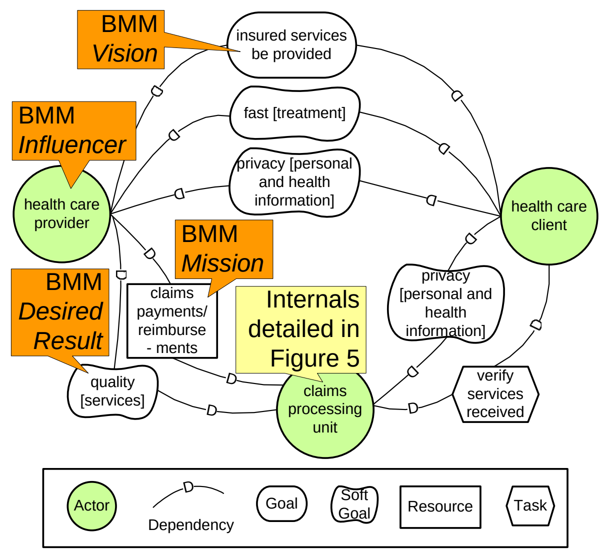

Fig. 4. An Exemplary i* Strategic Dependency Diagram in the Health Claims Payments Case

Furthermore, figure 4 adds detail by introducing new elements and shows how the i* notion of *actors* makes business motivations (i* *Goals* and *Softgoals*) traceable back to stakeholders (i* *Actors*). It also illustrates the network of dependencies between different stakeholders. In Figure 5, a complementary i* strategic rationale diagram illustrates the internals of a specific agent (the Claims Processing Unit) utilizing *task decomposition* to further refine high level motivations into more specific *goals* and *tasks*.

In the third step **List Business Problems & Root Causes**, the introduced i* models were investigated by means of i* *workability*-, *viability*- and *ability analysis*. These analyses aimed at identifying problems inherent in the existing architecture that needed to be addressed by improvement efforts. Figure 5 gives an impression how workability analysis can be conducted with i* SR diagrams. SR

[4] Because of space restrictions, we can only discuss parts of the intentional models developed in this case study. For further models and more details we point to [20].

diagrams represent an internal view of *Actors* and in this case, illustrate the task decomposition of the *Actor* claims processing unit that appeared in figure 4.

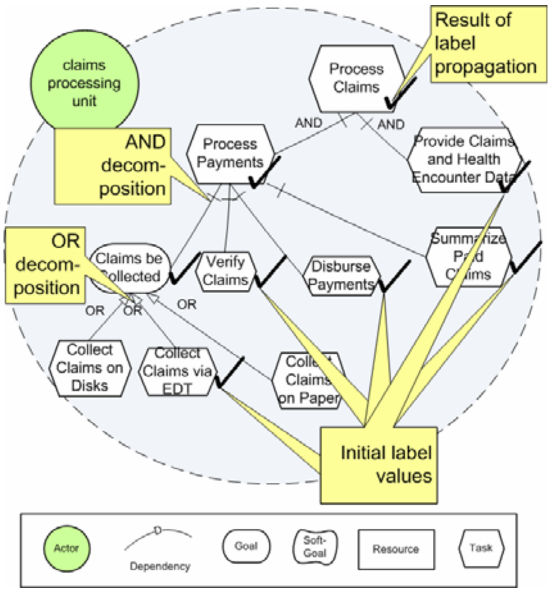

Fig. 5. An Example of Workability Analysis with i* in the Health Claims Payments Case

In figure 5, the business process process claims is decomposed into more detailed activities via a top-down approach (through AND and OR decompositions). This decomposition is subsequently evaluated in terms of its workability via a bottom-up approach, assigning initial label values to leaf-level elements, and propagating the evaluation values upwards (depicted in Figure 5 by means of check-marks). Thereby, the workability of the overall business process could be analyzed. Viability and ability analysis could be conducted in a similar way. The implications of certain design decisions (e.g. choosing the collection of claims via an EDT (Electronic Data Transfer) system over other available alternatives) were analyzed in terms of how they affect the *Goals* of other stakeholders by tracing dependencies back to the SD diagram (not depicted in figure 4). Here it is worth noting that with i*, evaluations can be propagated *algorithmically* through the network of *Goals* and *Tasks* (with human intervention when necessary [10]), so that the effects of evaluations become visible immediately.

The fourth step **Develop Alternative Enterprise Architecture Configurations**, focused on the generation of architectural alternatives. Four alternative enterprise architecture configurations were envisioned in this case study by, for example, selecting different alternatives in existing OR decompositions (as illustrated in Figure 5). For each potential alternative, i* SD and SR diagrams were developed to be able to reason about the different suggestions and evaluate all relevant implications in light of the different stakeholders' goals. These models of different alternatives captured the implications of different settings and thereby represented the basis for the next decision making step.

Finally, the fifth step **Select an Enterprise Architecture Configuration and Complete the Target Enterprise Architecture**, focused on the assessment of these alternatives in light of the identified stakeholders and their desires. Consequently, the architectural alternatives were analyzed iteratively, in multiple rounds, by utilizing the introduced goal evaluation algorithm and assessing each of the model elements in terms of achieving the *Goals* of multiple stakeholders (including potentially conflicting *Softoals* such as quality of service and low costs).

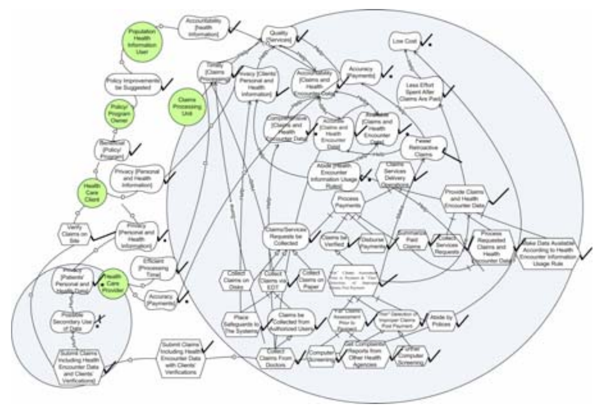

Fig. 6. Resulting i* Strategic Rationale Diagram for a Specific Architectural Solution in the Health Claims Payments Case

This introduces **a new kind of analysis** to enterprise architecture that allows for investigating the degree of goal achievement of a set of competing EA configurations in light of stakeholders' goals. Figure 6 aims to give an impression of the level of detail that was considered in this step. It illustrates the entire claims processing unit *task decomposition* in the light of one developed architectural alternative and the application of the i* *goal evaluation algorithm* to the model. In this figure, qualified contribution links between model elements such as *some+*, *some-*, *help*, *make*, *hurt*, and *break* [13] are introduced to further detail the kind of contribution. As introduced before, the qualitative i* labels *satisficed* ✓, *denied* ✗, *weakly satisfied* ✓., *weakly denied* ✗., *unknown* ?, and *conflict* were used to explore the effects of different architectural configurations. By contrasting and comparing the evaluations of different alternatives, a specific architectural alternative could be identified that had the best performance in light of the stakeholders' interests.

VI. Assessment

The potentials of intentional modeling concepts were assessed in two ways in this work: The first form of assessment included the application of the intentional modeling concepts in the context of a concrete application domain (the introduced health care case). The second form of assessment focused on obtaining and analyzing qualitative feedback from enterprise architecture practitioners, based on the developed case study material.

A. Case Study Observations and Experiences

In the case study, the selected intentional modeling languages (BMM and i*) turned out to be useful for a series of activities in an enterprise architecture context. While BMM provided an effective tool to lay out major business elements on a high level of (business) abstraction, including –*Means*, *Ends*, *Influencers* and their *Impacts*, i* provided concepts to further decompose these elements into *Goals*, *Softgoals*, *Tasks* and added the notion of stakeholders (i* *Actors*) to the modeling process. With i*, high level constructs of intentionality available in BMM (*such as desired results*) could be linked to traditional elements of enterprise architecture frameworks (such as *tasks*). During model construction, i* forced the enterprise architect to *clarify goals and intentions*, *add missing details*, *reduce redundancies* and *reflect upon different stakeholders' intentions*. As one of the most noticeable results, *the case study revealed that the application of intentional modeling concepts (such as goal evaluation) have the potential to enable enterprise architects to conduct analysis that have not been supported by enterprise architecture frameworks before*. i* goal evaluation aided the identification and evaluation of **goal conflicts and synergies** as well as the **generation and evaluation of architectural alternatives** and **reasoning about architectures**. Having explicit relationships between intentions and proposed enterprise architectures available helped in **justifying selected architectures** and obtaining commitment for resulting decisions from different stakeholders.

During the course of this study, some aspects emerged that suggest directions for further research. First, the distinction between different intentional modeling elements was not always easy to make (e.g. i* *Goal* vs. *Task*) since these concepts were not always that clearly separated in the case study environment. During qualitative i* evaluation of architectural alternatives, the iterative procedure led to situations where at different times, different labels were assigned to the same modeling element. This problem might be amplified when multiple persons are involved in the qualitative evaluation process. This observation raises the need for a more inter-subjective, possibly quantitative, reasoning algorithm. Also, as with many modeling frameworks, usability and comprehensibility of utilized modeling concepts and languages need to be considered in future research efforts.

B. Qualitative Assessment based on Interviews

Semi-structured interviews were conducted with a set of enterprise architecture practitioners. Between December 2005 and February 2006, four interviews were conducted with experts skilled in enterprise architecture, information management and knowledge management, to get feedback on the introduced concepts. The overall intention of these interviews was to gain further insights into the *applicability*, *appropriateness* and *completeness* of the introduced concepts. During the interviews, the intentional modeling concepts and the results (the developed models) of the case study were presented to the interviewees. Analyzing the interview transcripts, three main strengths of the proposed work could be identified:

1. Intentional modeling can introduce *rationality* to the enterprise architecture construction process, enabling *justified decision making* for enterprise architects.
2. Intentional modeling can provide *traceability* between high-level business objectives and low-level enterprise architecture elements, between business problems and root causes, and between change initiatives and rationales for selecting them. This can be attributed to the introduction of intentional modeling elements, qualified relationships, and associated analysis techniques.
3. Intentional modeling can stimulate *explicit, structured thinking* about business transformation and underlying drivers.

In addition, the interviews revealed that although some enterprise architecture practitioners initially regarded intentional modeling languages such as i* to be too complex and hard to read, they appreciated the analysis and evaluation abilities that come with such approaches. However, representing intentional models in a way that is easily comprehensible is something that research needs to address in the future. BMM was regarded to be helpful in providing specific conceptual categories at an enterprise-strategic level. While it represents a powerful tool for modeling intentions on a high abstraction level, extensions might be necessary to be capable of representing interrelationships among stakeholders and maintaining relationships between goals and concrete business activities such as tasks. Also, providing mechanisms that help decide to what extent expectations and goals are met would have been appreciated by the interviewees. Further insights obtained from the interviews include the observation that intentional modeling is regarded to be of use especially for situations that *deal with critical change*, where the implications of design decisions are *extensive*, *costly*, *decisions cannot be easily reversed* and there is *little room for mistakes*. The ability of intentional modeling approaches to experiment with different enterprise architecture configurations clearly supports such situations. Further feedback from EA practitioners referred to additional application domains of intentional modeling and analysis, including facilitating the development of *initial* enterprise architectures (vs. facilitating change where legacy architectures are already in place). Tool support was also regarded to be beneficial, to be able to, for example, query the complex models or automatically perform goal reasoning as well as workability, viability, and ability analysis. Critical feedback included the observation that, the conception of decision making is too rational and the case study models did not reflect political or organizational factors that might bias decision making processes to a certain extent.

VII. Conclusions and Future Work

In this explorative work, we have identified that there are a variety of prospects for incorporating intentional modeling into enterprise architecture. So far, we have only explored potential benefits and challenges in the context of business transformation. For future work, we intend to provide similar demonstrations for other areas of EA practice, e.g., alignment of business and IT architectures, policy compliance and governance, etc. The use of intentional concepts has been anticipated in recent EA literature as guidelines (e.g. p.5, [23]) - "If you want to achieve B, you can choose to do A"), but has not been elaborated in terms of modeling and analysis.

In order to be applicable in practical settings, intentional modeling concepts and analysis techniques would need to be more tightly integrated into established enterprise architecture models and practices. Intentional analysis concepts such as workability, viability, and ability analysis need to be integrated with richer enterprise architecture ontologies such as those in [9], [24] and [25], while concepts of service and value should also be included [26].

This work aimed to represent a first step towards a deeper exploration of intentional modeling and analysis for enterprise architecture. We hope that it motivates and triggers further, more comprehensive, research on the intentional (why) dimension of enterprise architectures.

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