

Variability of enterprise architecture elements in Finnish ePrescription projects

Hannu Virkanen, M.Sc.¹, Juha Mykkänen, PhD, adjunct professor¹, Mika Tuomainen, M.Sc.²

¹ University of Eastern Finland, School of Computing, HIS R&D, Kuopio, Finland

² Kela, the Social Insurance Institution of Finland, Kanta Services, Finland

Hannu Virkanen, University of Eastern Finland, School of Computing, HIS R&D, Kuopio, FINLAND. email: hannu.virkanen@uef.fi

Abstract

The governance of large eHealth initiatives is complicated by multiple viewpoints and autonomy of numerous different stakeholder organizations. In addition, the lifecycle of goals and requirements spans multiple different organizations, as well as various specification, development and deployment projects, application systems and products. Governance requires traceability of requirements and design decisions in the lifecycle of large-scale initiatives and between various levels of abstraction. Enterprise architecture (EA) approaches have been used for governance of complex and long-term intra- and inter-enterprise initiatives. We provide a model which we use to conceptually analyze variability of several EA elements throughout the extended lifecycle of development goals of projects related to national ePrescription in Finland. The analysis is based on case experience, material and interpretive methods in relation to nine projects. The analyzed elements and EA artefacts have been proposed as being especially central and relevant for many enterprise architecture initiatives. The results illustrate the differences in presence, plurality and abstraction level of central EA elements throughout the project continuum of ePrescription. The results highlight dependencies and transformations which are likely to be encountered in large-scale eHealth efforts in general. The results may be used to support the traceability and refinement of EA elements in the planning and governance of interdependent projects.

Keywords: governance, eHealth, enterprise architecture, variability

Introduction

Large-scale eHealth programmes have been initiated regionally and nationally in several countries as an integral part of health strategies [1]. These initiatives often aim to provide new eServices and an infrastructure for health and wellbeing information sharing. Such programmes are politically driven, aiming to increase the quality, continuity, integration and cost-effectiveness of care and to reduce overlapping activities and duplicate work, typically through improved availability of patient information throughout different services. Networked care supported by health information exchanges is inevitably changing the health services provision. Large-scale initiatives in health care and other industries, however, frequently seem to be prone to delays, exceeding budgets and only partially fulfilling their expectations and goals. Constantly increasing knowledge, changing organization models and technologies [2] require adaptability from technologies, architectures and development methods in such long-term and multi-lateral initiatives. In addition, the general change of socio-technical development context from systems development to services development promotes customer needs, evolution and co-production of value by providers and customers [3] and could also be applied for the transformation of healthcare. Not surprisingly, governance of large-scale initiatives has been especially emphasized on national and international arenas recently [4]. This is somewhat natural, as IT governance aims to ensure that the IT in an organization or a network supports and enables the achievement of its strategies and shared objectives.

Context: extended lifecycle in eHealth initiatives

Large-scale initiatives are driven by high-level policies and strategic goals of international networks, countries, regions and organizations. From these high-level goals, it is not always simple to draw traceability to the detailed tasks and design decisions required to deliver the required change in development and deployment efforts. Such traceability, however, is required for governance and justification of solutions and their features in relation to requirements [5]. One of key challenges

for governance is the extended lifecycle of large initiatives: lifecycles of goals, strategies, services, architectures, models and development approaches span multiple organizations and systems and outlive duration of individual projects. In addition, various autonomic actors participate in these programmes with their own goals and agendas. To large extent, the success of large-scale strategic initiatives is determined by local projects and interplay between processes, services, products and technologies from high-level goals to individual deployment and daily use of solutions. Thus, research is also needed on adaptability and traceability supported by service- and model-driven development and governance approaches throughout the extended lifecycle of goals and requirements [6].

The objective of this study is to use a generic enterprise architecture (EA) approach to develop and illustrate support for a) the traceability of solution requirements and features throughout the information systems development lifecycle and b) governance of complex and multilateral eHealth initiatives.

Methods: conceptual variability analysis of central enterprise architecture elements

The research methodology related to socio-technical information systems must take into account the complexity of real world and nature of the organizational, social and technical phenomena of interest. Case studies and descriptive / interpretive methods are suitable for research of both organization groups (such as cluster of projects) and methods (such as enterprise architecture frameworks). [7] To large extent, our analysis is based on case study-based action research [8, 9] in which experience and outcomes from practically-oriented development efforts is reflected to the structured analysis framework. Since it has not been possible to use such a participatory action research approach in all cases in our domain of interest, this approach has been complemented with descriptive / interpretive methods [10] through which the analysis framework is populated based on selected deliverables, workshop materials, discussions with project participants and even subjective reasoning of senior authors based on

their experience and expert opinion. Although such methods have risks of researcher bias in both observations and interpretations, they are applicable in complex information system contexts with numerous organizational, social and technological factors [7].

The realization of strategic goals is based on recursive inter-play between ends and means on various levels [11]. A high-level goal may lead to a development project which defines its own goals. These goals in turn are refined as requirements to which solution candidates and design decisions are based on, and so forth. This chain proceeds and branches from legislative and service system level down to organizational, product and process levels, and often also to software requirements and realizations. Various strategies, portfolios, projects and specifications are created and used throughout this lifecycle. In this paper, we focus on the observed *variability*¹ of enterprise architecture artefacts in different phases of this lifecycle. We discuss variability in relation to a) presence or absence, b) scope of impact in terms of number of organizations (plurality) and c) abstraction level of enterprise architecture artefacts.

In this study, we analyze the variability of central enterprise architecture elements throughout the lifecycle of several initiatives related to the introduction of nationally unified electronic prescription in Finland. Conceptual analysis is performed in relation to enterprise architecture elements and artefacts which have been proposed as especially reusable and useful in many projects. The traceability of these elements also illustrates multilateral dependencies in project clusters which share high-level objectives.

¹ In component-based software engineering, variability has been defined as an assumption true of only some elements, or an attribute with different values for at least two elements of a selected domain [9-12]. We apply this definition to complex enterprise and service systems, using projects as elements and selecting the presence/absence, plurality and level of abstraction as phenomena of interest in terms of variability.

The overall research question can be formulated as follows: *How are elements of central EA artefacts identified and refined throughout the extended lifecycle of a large-scale eHealth initiative consisting of several projects?* Through this analysis, we aim to exemplify the complex transformation of EA elements throughout the continuum of interrelated projects. The analysis of this transformation should enable us to observe dependencies and needs for governance which should be acknowledged in large-scale eHealth efforts in general.

We analyze variability in three dimensions. Firstly, variability is discussed in relation to presence (creation, reuse / refinement or absence) of the identified EA elements as a central consideration in each initiative related to the domain. This is determined by assessing if an initiative defines significant new ends or means to the element, if it reuses or refines the element acquired from previous projects or other sources, or does not consider the element as central part of ends and/or means of its own domain. Secondly, our analysis considers plurality in terms of scope of guidance or control: is the element considered for all organizations of the overall development context, an identified subset of organizations, or an identified individual organization such as one service provider or institution. Thirdly, the level of specification or deployment abstraction is considered on three levels applying generic and healthcare-specific enterprise methodologies [13,14]. Conceptual level considers generic identification, classification or high-level definition of phenomena. Logical level considers design, relationships and identification of number of elements in different classes. Physical level deals with instances, particulars, individuals, implementations and deployments. The project-specific selection between categories in each dimension used in this study is ultimately based on subjective assessment of the authors following guidance outlined in this section and knowledge of each initiative.

With this approach, we aim to highlight and discuss requirements, recommended practices, opportunities and pitfalls for the use of EA approaches in the governance of large-scale eHealth initiatives throughout their extended lifecycle. In general, EA approaches are used by organizations and projects for organizing and manag-

ing their information and technology services, business processes and IT infrastructure [15]. EA methodologies provide conceptual frameworks, methods and sometimes notations and governance frameworks for these tasks [13]. Frameworks and notations are also available to support the modelling of goals and requirements which are central drivers of the architecture development process [16]. EA methodologies can also be used for domains other than single enterprises, including national and multilateral eHealth initiatives. EA has been proposed as a necessary mechanism for business / IT alignment and IT governance [13,15].

For analysis of this study, we selected TOGAF 9 EA framework [15]. Part of the framework is a defined set of EA artefacts which are grouped in eight categories according to method phases and architectural viewpoints. With viewpoint-specific extensions, this part contains 56 named artefact types. An artefact consists of an artefact type (e.g. "application portfolio") and a representation type (e.g. "catalog").

It is not reasonable to perform analysis with all artefact types, as all types are seldom used comprehensively or equally important. In addition, there are EA guidelines and proposals in EA literature and practice which emphasize the use of a few "central" artefacts as a basis for EA and its governance. Thus, we selected the following three proposals for subsets of EA artefact types to be included as elements for our analysis.

JHS 179 recommendation is a Finnish public administration recommendation for use of EA methods and artefacts [17]. Several templates have been provided for those EA artefacts which have been identified as necessary. Elements of these templates were selected as candidates for central EA descriptions in our analysis. Several other artefacts are also included in JHS recommendation but they have not been provided with readily made templates or cannot be directly mapped to TOGAF 9 artefacts. The recommendation uses the conceptual / logical / physical level categories [17], thus we also included these levels as part of our analysis framework.

Greefhorst has recommended essential TOGAF EA artefacts, based on experience gained in financial and public sector EA work [18]. Elements of these recommended artefacts were also selected for analysis.

Handbook for EA development in Finnish higher education [19] is a recent guide for the use of EA in universities in Finland. The handbook proposes seven EA artefacts which are especially useful for the identification of development points for enterprise architecture. These artefacts were also selected and mapped to the TOGAF artefacts for our analysis.

The resulting set of central EA elements included 21 identified elements based on TOGAF artefacts whose variability can be conceptually analyzed in large-scale eHealth programmes. These include: principles, value chain descriptions, drivers / goals / objectives, organizations / actors, concept relationships, processes, data entities, data flows, data repositories, information system services, processes in relation to data, systems in relation to data, functional decomposition / systems map, processes in relation to systems, application portfolio, systems in relation to functions, application communications, interfaces, technology services, technology standards and technology portfolio. Nine of these artefact types were recommended by more than one source.

There are various techniques such as Bayesian networks, influence diagrams and I* which can be used to evaluate and analyse enterprise architectures [20]. To some extent, these models can also be applied for the analysis of causal chains between goals and descriptions of large-scale initiatives.

In this paper, however, we do not try to enumerate all explicit goals of various levels and phases but we focus on the variability analysis of proposed central EA artefacts in projects which have not been originally using an explicit EA framework.

Case material: ePrescription projects in Finland

The final building block of our analysis is "case" or a set of eHealth projects which share some common goals of a larger initiative. We selected a set of projects and initiatives related to the specification, implementation and deployment of national ePrescription in Finland. There are various legislative, functional, information and technology goals, requirements and solutions from national, regional, local, professional and commercial viewpoints related to the national ePrescription, as well as number of national and local projects. Thus it is an attractive candidate for analyzing the extended lifecycle of large initiatives in a very multilateral environment.

Prior to 2010, prescriptions have been written using EPR systems and printed for the patient by majority of physicians and healthcare providers. The national ePrescription centre was specified as the first national level IT service in Finland [21]. Its goals include reduction of errors (such as handwriting and unclear instructions), improved overall management of medication and elimination of counterfeits and lost prescriptions. In addition, improvements in dispensation and renewal processes such as renewal requests through pharmacies, and uniform service level across different organizations and systems are pursued.

The IT architecture of national IT services including ePrescription is based on centralized service (prescription centre for ePrescription) and IT messaging bus, and the use of local or regional EPR or pharmacy system products by healthcare organizations connected to the national services using standard interfaces [21]. The initiative has been led by the ministry of social affairs and health in a highly networked environment of several national institutes, municipalities, hospital districts, and competing software vendors.

The following projects and initiatives related to the national ePrescription solutions are discussed in this paper:

1. Legislation: the legislative process to support ePrescription by the Ministry of Social Affairs and Health, resulting in law on ePrescription, decree on ePrescription and sections in the law of electronic client documentation.
2. Kela specification: the specification project by the National Insurance Institute (Kela) for ePrescription, resulting in use cases, requirements specifications, authorization specifications, information specifications and other analysis and design documentation for the national ePrescription centre and pharmacy and EPR systems.
3. HL7 CDA: the interface specification projects by HL7 Finland Association, resulting in HL7 version 3 messaging and HL7 CDA R2 document standard implementation guides to support the implementation of interfaces to the national ePrescription service, pharmacy systems and EPR systems.
4. TJSERT: The certification project by the National Institute for Health and Welfare (Stakes / THL), resulting in ePrescription and national EPR archive certification requirements for healthcare organizations, pharmacies and their information systems, respectively.
5. KuntaIT integration architecture project: specification project of integration architecture options for municipalities joining the national ePrescription services, by the Ministry of Finance and the Association of Local and Regional Authorities.
6. KanTa implementation: implementation project of the national ePrescription centre, national medication database and national messaging / enterprise service bus platform by the National Insurance Institute Kela and the selected implementation vendor.
7. Product implementations (several projects): individual implementation projects for pharmacy and EPR system products by the system vendor companies, consisting of three major pharmacy systems and five major EPR systems (which have been connected to the prescription centre).
8. Audit project: the product audit process by the Ministry of Social Affairs and Health, implemented by a consultancy company in which the implemen-

tation of legislative requirements and specifications is audited in products.

9. Local deployments (several projects): the deployment projects in which systems are deployed in pharmacies, health centres and hospitals, users are educated to use ePrescription functionalities and local systems are connected to the national services by the municipal or regional organizations, system vendors and Kela.

As of November 2012, hundreds of pharmacies and municipalities or hospital districts have deployed systems with national ePrescription, and more than 4,1 million ePrescriptions and 4,8 million dispensations have been delivered through the overall system.

The authors have actively produced deliverables in projects 3 and 4, commented outcomes and participated through working groups in projects 1 and 2, and actively collaborated and discussed with participants without actively engaging in projects 5-9. Document analysis of documentation has been used for all projects in which it has been available as additional basis of analysis. Interpretations of the use of different EA elements in projects are based on these material, participations and connections, following an action research and participatory-interpretive research approach. As there was no detailed material on all projects and the elements in projects do not always have direct correspondence to TOGAF elements, interpretation of authors is used especially for projects 7-9. Thus, the research is not based on accurate analysis of quantitatively measurable set of material. Such approaches are typical in information systems field [7] in which diverse and complex relationships must be taken into account. The research is interpretive [10] and partially based on action research performed by the authors through varying levels of participation in case projects. Subjective interpretation of elements of projects in relation to the models used as a framework is

used to highlight observations which are structured according to the underlying EA framework.

Previous pilot project for ePrescription which did not deliver sustainable solutions and an ePrescribing pilot section of pan-European epSOS project between Finland and Sweden are omitted from this paper, as the authors are not familiar with them or as they do not have direct effect on the introduction of the overall national solution. In addition, the analysis does not include the security infrastructure project of the National Supervisory Authority for Welfare and Health (Valvira) which produced national support services for digital signatures and certificates for all national health IT services. Despite this, the authors believe the results illustrate the main variability points in the extended lifecycle of ePrescription projects.

Results: variability of EA elements

The results of analyzing the projects in relation to central EA elements are presented in Tables 1, 2 and 3. Each central EA element (row) is considered for each project (column) according to the presented method. By following the rows, variability and traceability in these dimensions can be observed between projects for a given element type. By following the columns, the scope of each project can be summarized in relation to element types.

Intersection cells in Table 1 summarize analysis of presence of each EA element as described in Methods. The presence, reuse / refinement or absence of each element is considered. If the element is not deemed central in the project, no other dimensions are analyzed. The following values in cells of Table 1 represent variable presence or absence of elements: "S" = Stated/specified, "u" = Reused/refined, "-" = Absent or implicitly assumed.

Table 1. Presence or absence of EA elements in projects.

Element	Initiatives								
	1. Legislation	2. Kela	3. HL7 CDA	4. TJSERT	5. Kuntair	6. KanTa	7. Products	8. Audit	9. Deployments
Principles	S	S	-	u	S	u	u	u	u
Value chain	-	S	-	-	u	u	u	u	u
Drivers, goals, objectives	S	u	-	u	u	u	u	u	S
Organizations / actors	S	u	u	u	u	u	u	u	S
Concept relationships	-	S	S	u	u	u	u	u	u
Processes	-	S	u	u	S	S	S	u	S
Data entities	-	S	S	u	u	S	u	u	u
Data flows	-	S	S	u	u	u	u	u	S
Data repositories	S	S	u	u	u	S	S	u	S
Information system services	S	S	u	u	S	S	S	u	u
Processes + data	-	S	u	u	S	S	S	u	S
Systems + data	-	S	u	u	u	S	S	u	S
Functional decomposition / systems map	-	S	u	u	S	S	S	u	S
Processes + systems	-	S	u	u	u	S	S	u	S
Application portfolio	-	-	-	-	S	-	-	-	S
Systems + functions	-	S	u	u	u	S	S	u	S
Application communication	-	S	S	u	S	S	S	u	S
Interfaces	-	S	S	u	u	S	S	u	u
Technology services	-	S	-	u	S	S	S	u	S
Technology standards	-	-	S	u	-	S	u	u	u
Technology portfolio	-	-	-	-	-	S	S	-	S

Cells in Table 2 consider plurality of organizations to which the specifications of each project are applied to. It must be noted that plurality is determined by the intended set of users of the deliverables of the project, "all" denoting all organizations (service providers, pharmacies, institutes) which are within the scope of ePrescription solutions. The following values in cells of Table 2 represent variable plurality of elements: "A"=All applicable organizations, "S"=Selected several organizations, "I"=Identified individual organizations.

Cells in Table 3 are interpretation of abstraction level of each element in each project according. Abstraction is

considered in relation to conceptual analysis, logical design and physical deployment or implementation, following the three-level definition of the Methods section: "C" = Conceptual / generic, "L" = Logical / designed, "P" = Physically deployed / implemented.

It is important to note that most of the projects did not use TOGAF artefacts or selected elements as such: the presence of elements as central in the project is evaluated based on documentation or author estimates as described in previous sections, as some elements were not a specific to ePrescription but had to be taken into account as the solutions were refined.

Table 2. Plurality of EA element specifications in projects (for which organizations the element is defined).

Element	Initiatives								
	1. Legislation	2. Kela	3. HL7 CDA	4. TISERT	5. Kuntair	6. KanTa	7. Products	8. Audit	9. Deployments
Principles	A	A	-	A	S	I	S	S	I
Value chain	-	A	-	-	A	I	S	S	S
Drivers, goals, objectives	A	A	-	A	A	I	S	S	S
Organizations / actors	A	A	A	A	A	I	S	S	S
Concept relationships	-	A	A	A	S	I	S	S	I
Processes	-	A	A	A	S	I	S	S	S
Data entities	-	A	A	A	S	A	S	S	I
Data flows	-	A	A	A	S	I	S	S	I
Data repositories	A	A	A	A	A	I	S	S	I
Information system services	S	I	S	S	S	I	S	S	I
Processes + data	-	A	A	A	S	I	S	S	I
Systems + data	-	A	A	A	S	I	S	S	I
Functional decomposition / systems map	-	A	A	A	S	I	S	S	I
Processes + systems	-	A	A	A	S	I	S	S	I
Application portfolio	-	-	-	-	S	-	-	-	I
Systems + functions	-	A	A	A	S	I	S	S	I
Application communication	-	A	A	A	S	I	S	S	I
Interfaces	-	A	A	A	S	A	S	S	I
Technology services	-	I	-	S	S	I	S	S	I
Technology standards	-	-	A	A	-	A	S	I	I
Technology portfolio	-	-	-	-	-	I	S	-	I

Table 3. Abstraction level of EA elements in projects.

Element	Initiatives								
	1. Legislation	2. Kela	3. HL7 CDA	4. TISERT	5. Kuntair	6. KanTa	7. Products	8. Audit	9. Deployments
Principles	C	L	-	L	L	P	P	P	P
Value chain	-	C	-	-	C	P	P	P	P
Drivers, goals, objectives	C	L	-	L	L	P	P	P	P
Organizations / actors	C	L	L	L	L	P	L	L	P
Concept relationships	-	L	L	L	L	L	L	L	L
Processes	-	L	L	L	C	P	P	P	P
Data entities	C	L	L	L	L	P	P	P	P
Data flows	C	L	L	L	L	P	P	P	P
Data repositories	L	L	L	L	L	P	P	P	P
Information system services	L	L	L	L	L	P	P	P	P
Processes + data	-	L	L	L	L	P	P	P	P
Systems + data	-	L	L	L	L	P	P	P	P
Functional decomposition / systems map	-	L	L	L	L	P	L	L	P
Processes + systems	-	L	L	L	L	P	P	P	P
Application portfolio	-	-	-	-	L	-	-	-	P
Systems + functions	-	L	L	L	L	P	P	P	P
Application communication	-	L	P	L	L	P	P	P	P
Interfaces	-	L	P	L	L	P	P	P	P
Technology services	-	L	-	L	L	P	P	P	P
Technology standards	-	-	P	L	-	P	P	P	P
Technology portfolio	-	-	-	-	-	P	P	-	P

Discussion: consequences for governance

Based on the results, we can observe that central EA elements are variably identified and refined in the extended lifecycle of the project cluster. Some elements remain on logical level, while most elements are initially specified on conceptual or logical level but gradually instantiated on the physical level during system development and deployment. Local specification of many aspects takes place in deployment phase, complementing generic or product-specific solutions with local conventions or configurations.

Some important "exceptions" to this rule can be observed in ePrescription project continuum through the projects the authors are the most familiar with: for example, both the implementation experience from KanTa implementation project (6) by Kela and legislation changes (1) produced changes to the interface specifications (HL7 CDA) (3) used by all organizations. In addition, certification (TJSERT) (4) and audit (8) projects which mainly use or refine generic specifications or product implementations were hampered by simultaneously changing specifications in related projects (Kela specification (2), Legislation (1) and HL7 CDA(3)). These dependencies are illustrated by earlier projects specifying many elements for all stakeholders and latter projects using and refining them for all, specified or individual organizations. In practice, however, many of these changes did not have strong influence on overall landscape typically emphasized in enterprise architecture artefacts, but on a rather detailed design level.

"Specify for all" (Table 1: S, Table 2: A) projects include legislation, Kela specifications and HL7 standards initiatives. The TJSERT certification project, however, which actually specified requirements for all stakeholders, cannot be identified in this group, as it only re-stated requirements and produced tests based on already existing specifications. Another central group is "Specify for individual deployment" projects (Table 1: S, Table 2: I, Table 3: P) which in this continuum include product and national implementation projects and local deployment initiatives. Not even all physical deployment projects, however, have EA artefact documentation in TOGAF sense, although their elements can be identi-

fied, respectively. Some artefacts such as application portfolio in TOGAF sense were mostly absent throughout the continuum. As ePrescription can be seen as a solution architecture instead of "complete" architecture of any enterprise, careful attention should be paid to the application and selection of those elements which are especially necessary for coordination and traceability.

The product development (7) and auditing (8) projects are closely connected and serve multiple client organizations of each vendor. In addition, a refined integration architecture project (5) was found necessary for unifying the integration topologies across multiple vendors and user organizations. It must be noted that TJSERT project (4) identified certification requirements for site-specific deployments (9) in addition to product certification (8). Self-audit in organizations (in projects 9) complemented with connectivity testing with the prescription centre (of project 6) upon each organizational deployment was found an adequate solution. A degree of certification on both generic product level and in concrete organizational contexts seems necessary.

The national projects focus on providing logical level guidance for all stakeholders and various implementation / deployment projects, the national KanTa service implementation project (6) being an exceptional case of individual implementation. Specificity is observed early in the continuum in relation to interfaces and standards, whereas processes, detailed data flows and many other aspects are still refined on local level. Such flexibility and autonomy must be respected despite agreements for semantic interoperability [6].

It can be argued if so many projects on national and local level are really needed for delivering national goals. Certainly, risks related to continuity of development and synchronization between initiatives can be observed. The results of the analysis as well as the successful deployment, however, suggest that engaging different stakeholders using dedicated projects has been somewhat successful in such ecosystem of autonomous organizations and reduced "not invented here" syndrome. Change management and corrections in

specifications have been solved using repeated national projects, including legislation. Consequently, local product development and introduction has been slowed down by delays in national specifications. In general, it is difficult to find balance between providing implementable specifications early in the lifecycle and avoiding repeated fixes and refinements.

Alignment of organization-specific and national strategies could not be evaluated as part of this study. This would be especially necessary if there was no strong legislative obligation to use the national solutions.

Similar studies could be performed in other initiatives such as development of national social services IT, but detailed analysis would require long term engagement in various projects and always remains partially subjective despite research guidelines. The selection of TOGAF artefacts as analysis elements provides a useful model and structure for analysis, but is non-optimal. The interpretation of elements can be performed in different ways by different organizations and researchers, thus is partially subjective to the interpretation of the authors. The TOGAF artefacts do not have formal and generally accepted definitions. In addition, many proposed elements partially overlap with each other. Despite these risks associated with the involvement and interpretation of the researchers in the context of the investigation [9], the results do suffice to illustrate the variability of various factors in interrelated projects and enable us to make observations on dependencies and potential governance needs. To some extent, these needs and observations may be generalizable to other large-scale initiatives as well. In a related (yet unpublished) research, we have been using "normalized" enterprise architecture elements based on Archimate standard which provide a more well-defined set of basic elements. The downside is an increase in the number of elements to be identified and analyzed.

Techniques such as extended influence diagrams [20] and motivation extensions [16] have been proposed to support analysis of causal relationships and requirements in enterprise architectures. Investigation of such relationships in terms of artefacts discussed in this paper would be an interesting aspect for further re-

search. However, there are numerous goals in different phases of overall chain of projects and a careful selection of which goals to be analyzed would be needed.

Through this analysis, we aim to exemplify the complex transformation of EA elements throughout the continuum of interrelated projects. The analysis of this transformation should enable us to observe dependencies and needs for governance which should be acknowledged in large-scale eHealth efforts in general.

Conclusions

Large-scale initiatives in today's networked society and service ecosystems require agility but also long-term governance. Traceability and understanding of temporal as well as design and system-level dependencies creates necessary prerequisites for governance and measurement of large-scale initiatives and their constituent projects. Our model and example illustrate the use of EA frameworks to support such traceability as well as shortcomings of using EA approach with proposed high-level artefacts only. The analysis demonstrates the complex nature of large and multilateral eHealth initiatives and highlights the importance of change management in relation to presence, plurality and abstraction of central elements throughout the extended lifecycle of large-scale eHealth initiatives.

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