

An Enterprise Architecture Perspective to Electronic Health Record Based Care Governance

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Abstract. This paper proposes an Enterprise Architecture viewpoint of Electronic Health Record (EHR) based care governance. The improvements expected are derived from the collaboration framework and the clinical health model proposed as foundation for the concept of EHR.

Keywords. Care, Electronic Health Record, Enterprise Architecture, Governance, Systems, Services, Autopoiesis, Component Criticality

1. Introduction

Healthcare Records are an evolving capability in healthcare. They have shown up in the history of our civilization as clinical services logs in Babylonian times, on Egyptian papyruses nearly 4000 years ago, as wax tablet documented procedures and case studies 2000 years ago in Roman Legion medical services. With the apparition of digital technologies, printed records of care have become the backbone of Electronic Health Records or EHR capability of our modern Healthcare Practice.

Digitization has brought changes to the use of clinical information. From billing and taxation – the initial motivation even in the ancient Babylon, digitized electronic health records have enabled standardization, knowledge extraction and composition, decision and action support and more. From information stored and managed in digital format, the concept of EHR has become an action enabling capability. Unfortunately, this transformation occurs more impromptu than planned.

This confusing roadmap in the development and use of EHR, coupled with the libertarian policies behind social funding of implementation efforts around the world have made the effectiveness of EHR use in care a subject of controversy and low adoption rates when compared to similar methodologies used in non-medical domains of expertise (ex: Architectural and Development Frameworks in technical fields).

In this paper, we are proposing an Enterprise Architecture perspective to the development and use of EHR as a means of optimizing Care delivery governance as a successful societal and business practice.

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2. Approach

The proposed model ontology is described in [Figure 1](#) below. The proposed model uses the concepts of systems, services and autopoietic systems, with a focus on certain properties related to them, integrated in a generic governance process.

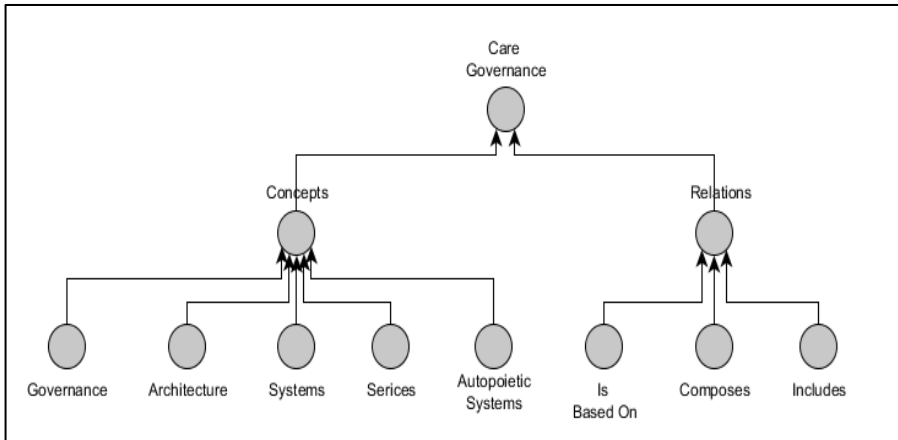


Figure 1. Simple EHR based Governance Ontology

Each of these concepts brings specific modeling abilities that help us reduce the complexity of the topic and identify opportunities and risks.

2.1. Defining our Terminology

Systems are sets of elements aggregated by relations that give the set a defining functionality. The core feature of a system is its characteristic function that none of a system's components provide.

A service is a self-contained agency responding to a consumer's need. The benefit of using the concept of service in our modeling activity is the hiding of implementation details it provides; a service is known through the function it provides and identification.

Autopoietic Systems are a specialization of the notion of systems. This model has been offered to us by Francisco Varela and Umberto Maturana in their effort to capture the critical function of living systems. The core signature of an autopoietic system is the fact that it self-produces and self-maintains.

Architecture as a concept attracts more and more attention to the overlapping boundaries of business and technology specializations. Architecture is the activity of building a model whose implementation fosters a given behavior. Architecture is a behavior modulator. Examples include buildings, tools, software that result from architectural models and inspire us to live and work in certain ways. The concept of architecture provides a proprietary way of classifying concerns by grouping them in categories of motivation, knowledge, function and implementation.

Governance is the process of fostering action oriented collaboration of diversified stakeholders towards a well-defined goal. The governance process builds common knowledge, achieves understanding, shared ownership and coherent action.

2.2. Diving Deeper in the Modeling Framework

The generic definition for the governance process above suggests the interdependence between good governance and improved care outcomes. Care is a multi-stakeholder process (the owner of health being one of them) that builds collective knowledge of the domain, identifies challenges and defines solutions that are implemented through a collective effort.

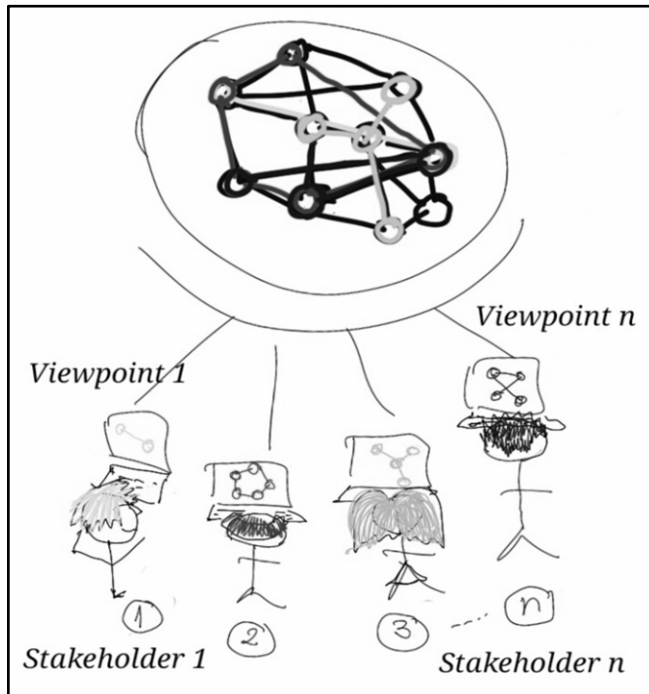


Figure 2. A sketch showing the essence of good governance: integration of knowledge from multiple stakeholders and support for further collaboration.

We will focus here on clinical aspects of health, violating the systemic approach that includes many other contributing components of the state of wellness.

The complexity of the body of knowledge behind our state of health is high and continuously self-improving: 70 trillion cells, more than half with different genetic makeup, collaborating in a dynamic equilibrium that defines the state of health of this community for durations of orders of magnitude their own lifespan.

Staying healthy is synonym to preserving collaborative equilibrium of this community of agencies.

2.3. A Simplified Model for Health

Varela and Maturana in their 1973 book *Autopoiesis and Cognition: the Realization of the Living* [1] the authors have proposed a new type of system as an adequate model for biological life. This subclass has its specific function [2] recursively implementing and maintaining the system. Autopoietic systems self-produce and self-maintain. Later

work with this model has shown its utility in cognitive sciences, social sciences and immune systems theory to name just a few.

I have combined the autopoietic model with a special pattern related to living systems studied more recently by Laszlo Barabasi [3] and re-named “preferential attachment”. Preferential attachment is a recursive integration pattern that shows up everywhere where life has an influence, from biochemical networks in the cell to the Internet.

The signature of the preferential attachment pattern is a power law distribution of criticality for the components that make up an autopoietic system (Figure 3).

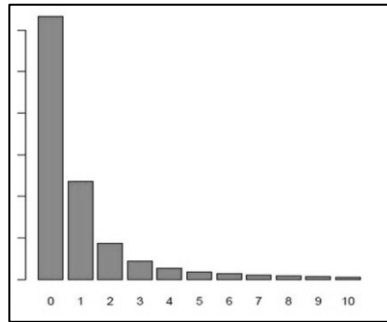


Figure 3. Power Law Histogram as a specific structural signature for autopoietic systems.

A power law structural criticality histogram suggests the following:

- In autopoietic systems, a very low number (bin 0 in Figure 3) of components preserve its integrity (ability to self-create and self-maintain) while most components (bins 3 to 10) have a decreasing supportive contribution.
- A systemic effort to preserve or restore autopoietic integrity is more effective when directed towards critical components. Such prioritization brings orders of magnitude effectiveness increases in the autopoietic maintenance process.

Within this paper’s scope, autopoietic systems are used for modeling organisms. The degree of autopoiesis (the specific function of autopoietic systems) is a model for the health of that organism. The structural property of autopoietic systems points to a significant difference in criticality for different psycho-physiological functions that are part of the health of an organism.

2.4. Health Disturbances

Grossly simplified, the challenges to a subject’s clinical health can be categorized as follows:

- Errors of blueprint (genetic endowment)
- Excessive distress (disruptive systemic stress)
- Accidents (dysfunctions of isolated health components)
- Wear and Tear (drifts of regulation due to cumulated errors)

To complicate the picture, these challenges usually compose; different subjects with specific genetic endowment under similar distress conditions and subject to similar accidents would show different clinical outcomes for the same clinical output

(executed care plan). Without means to capture these experiences and learn out of them, progress in the philosophy of care (art and science) would be difficult.

Placing health disturbances in an autopoietic model points to the following care challenges:

- Systemic challenges (errors of blueprint, distress, wear and tear) are distributed over many components of the autopoietic system. Such a distributed impact needs systemic intervention, the most complicated type of care where EHR based governance has maximum gain.
- Accidental challenges can affect either critical or support components. A damage to critical components needs immediate attention targeting the quick recovery of the lost function while damage to support components are usually subject to self-healing and need only supportive care.

2.5. Acting on Critical Health Challenges

Care is a complicated enterprise. Its complicated nature comes from the multitude of specializations it composes and the specific of each subject of care.

Essential to improving collaboration between strongly differentiated stakeholders is the process of learning, capturing solutions, understanding and sharing.

One such framework that enables capturing, understanding and sharing is the Enterprise Architecture framework or EA. EA is a new tool that goes through its growing pains.

Putting care in an Enterprise Architecture framework suggests the following associations:

- Motivation for care – sustainable improvement of wellness for care subjects.
- Knowledge – multiple bodies of knowledge and clinical information, structured for ease of retrieval and understanding
- Function – the system of actions and processes that lead to improving and maintaining health
- Implementation – the resources, tools and infrastructure that help us perform the function of care.

It is such a framework that this paper wants to propose as a model for the future of Electronic Health Record (EHR).

An EA inspired EHR would lead to the formatting of care procedures similar to approaches taken in services oriented architecture where information is hidden behind functions and motivations can be tracked down to atomic care activities.

3. Conclusion

This paper proposes the use of EHR as a complete Enterprise Architecture of the enterprise of care. Modeling health as the autopoietic function of an autopoietic system brings motivation to the EA approach by focusing care on critical components of the autopoietic function of our model, the subject of care.

EHR seen as an Enterprise Architecture exhibits the four dimensions described by TOGAF EA framework: motivation, information, function and implementation. Such an approach to EHR would reorient its future development towards a services approach

where motivation, information, functions and implementation are tightly grouped in decision and care oriented capabilities for the enhancement of clinical outcomes.

4. References

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