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ORIGINAL ARTICLE / TELEEXPERTISE

Systemic modeling in telemedicine

Modélisation systémique en télémédecine

B. Kamsu-Foguem

Laboratory of Production Engineering (LGP), EA 1905, ENIT-INPT University of Toulouse, 47, avenue d'Azereix, BP 1629, 65016 Tarbes cedex, France

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Summary The complexity of the health care system is a particularly notable framework for the development of telehealth and telemedicine. It is therefore necessary to try to answer the relevant question that can be summarized broadly as ''How to manage this complex system?'' We will discuss here the relations between system engineering and telehealth, or more specifically how systems engineering can be applied in the design of a telehealth system, and what benefits it can bring in its development. This naturally leads us to think of methods you can use to understand the difficulty of decision-making and the conceptual perspectives. It has been an accepted fact that this first requires modeling, i.e. to construct a representation of the perceived reality through symbols and relevant rules, then to verify or validate in absolute terms this representation, model, so as to improve or be able to use it. The importance of this modeling and the rigorous analysis of the requirements of telemedicine systems are even more apparent since the recognition of the generic representation declined in two meta-models: the first covers the activities of teleconsultation, teleexpertise and teleassistance; the second concerns telemonitoring.

MOTS CLÉS
Télémédecine ;
Approche centrée sur le patient ;
Holisme ontologique ;

Résumé La complexité du système de santé constitue un cadre particulièrement marquant pour l'essor de la télésanté et de la télémédecine. Il est donc nécessaire d'essayer de répondre à la pertinente question qui peut se résumer globalement ainsi « Comment mieux maîtriser ce système complexe? ». Nous allons donc étudier ici les rapports que peuvent entretenir l'ingénierie système et la télésanté, ou plus concrètement comment l'ingénierie système peut s'appliquer lors de la conception d'un système de télésanté, et quels bénéfices elle peut apporter dans son développement. Ce constat nous amène naturellement à réfléchir aux méthodes que l'on peut employer pour appréhender cette difficulté d'un point de vue décisionnel, d'une part, et

E-mail address: Bernard.Kamsu-Foguem@enit.fr

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conceptuel, d'autre part. De manière communément admise, cela nécessite de modéliser tout d'abord, c'est-à-dire de construire une représentation du réel perçu au moyen de symboles et de règles pertinents, de vérifier ensuite, voire de valider dans l'absolu cette représentation, ce modèle, de manière à l'améliorer ou à pouvoir l'utiliser. L'importance de cette modélisation et l'analyse rigoureuse des besoins des systèmes de télémédecine sont encore plus évidents depuis la reconnaissance des projets prioritaires dont la représentation générique se décline en deux méta-modèles : le premier porte sur les activités de téléconsultation, téléexpertise et téléassistance ; le second concerne la télésurveillance.

Introduction

From the perspective of systems engineering, the health program is complex. Its operation is the result of multiple equilibriums arising from interactions between many elements and processes. It is itself interacting with all levels of modern society, e.g. an economic or legal point of view, but also with all sources of health risk issues associated with medical practices and the development of the regulatory and institutional context in Europe. Acting on the health system means changing balances or seeking new ones. Introducing telemedicine is making new interactions possible between patients and caregivers, creating new interfaces.

There is room to improve the healthcare system for patient management, although any changes here must not affect the existing balances between the system components. In other words, all telemedicine policies should aim to reduce territorial disparities and at least preserve existing balances or create news ones within the healthcare system.

Systemics and complexity

For decades, a concept has emerged that can help to solve complex problems in various fields by strong abstraction mechanisms and a number of interesting concepts of generic representation. The systemic approach has complemented if not replaced in some areas the traditional Cartesian approach that has shown its limits.

The system definition adopted in this manuscript is that given by [2]:

> *''A system is a set forming a coherent and autonomous unit of real or conceptual objects (hardware, people, actions...) organized around a goal (or a set of goals, objectives, aims, projects...) by means of a set of relationships (mutual interactions, dynamic interactions...), all immersed in an environment''.*

A common characterization of the systems is to distinguish those that are complicated from complex ones. A complicated system cannot be understood at first by a person who considers it in his analysis. However, a minimum of information, time and Cartesian approach effectively allows understanding and control of it. For example, a machine that uses the wind to drive pumps, remote control or some intelligent processors can be complicated to use. On the contrary, a complex system [3] cannot be, at any given time, known exhaustively. For example, a healthcare system or even a living organism can never be fully described because it is composed of heterogeneous elements, behaviors and interactions with each other and their environment still unpredictable as they emerge from this contextual organization of the system. This means that a large part of the requirements and knowledge of the system escapes the one who believes. Systemics presents itself as the most excellent way to address the complexity, since it helps to organize the methodology for dealing with a largely unknown system from a person who considers it. Systemic concepts break down traditional disciplinary barriers and provide design research to be relevant to policy-making in complex environments.

Systemics and totality principle

The systemic approach [4] is to apply this system concept definition and the resolution of the problems posed by it. For this purpose, this approach seeks to link together instead of isolating as a Cartesian approach would, it is therefore based on the overall perception rather than a detailed analysis, considering the interactions rather than the elements and emphasizing the study of transactions taking place at the interface points between the system and the environment. Finally, it provides a focus on the dynamic and interactive aspects that sets up the vision reality. The totality principle therefore occupies a place in systems thinking. It states that a system cannot be reducible to its parts. Concretely, this means that it is essential to know the system requirements to consider the relationships linking its elements. Based on this principle, there are summative and constituent system requirements. Summative requirements of a system are the sum of the requirements of the different elements that constitute it. The component requirements include summative but also those resulting relationships linking the elements requirements. The difference between summative and constituent requirements of a system is what is sometimes called the concept of emergence or the ''system effect''. This concept is often found as a key study and progress in many fields (biology research, service engineering, psychology, artificial intelligence, etc.). In particular, its application to a complex system of services shows patterns