

SMART CITY: SMART NAVIGATION IN HOSPITALS

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Abstract: *The presented paper deals, in theoretical and conceptual terms, with one of the Smart solutions in the concept of Smart City. A smart solution can be defined as an innovative and functional approach towards solving situations in a responsible way and with positive consequences for society. These smart solutions are the core of the Smart City concept which, together with a smart region, present a new economic area where new markets or market segments offering innovative and intelligent (tangible and intangible) solutions for said cities and regions are developed. Specifically, the paper deals with the description of existing and innovative navigation systems in hospital buildings. Emphasis is placed on the analysis and comparison of indirect, explicit effects related to individual ways of navigation in hospitals. Knowledge of these effects, or their monetary quantification, is a key factor in assessing the effectiveness of the innovative solution and thus forms a specific input attribute in the decision-making process on implementation or rejection of such an implementation proposal.*

Keywords: *Smart, Navigation, Hospitals, Indirect effects.*

1. INTRODUCTION

Smart cities are a topic whose key importance is increasingly being recognized across both academic disciplines and urban planning. The idea of a smart city is a dream of urban planners all over the world, and a subject of many research and business initiatives as well as policy debates (Borsekova et al., 2018). The Smart City concept is currently an accented approach to that we would like to use to refer to the use of highly sophisticated analytical methods, approaches, communication methods and techniques for proposing aims, approaches and plans involving the whole field of transfer of smart solutions into tangible and intangible innovations in a particular locality (Turečková & Nevima, 2020). The core of the concept is to transform the city into a dynamically developing city based on its sustainable economic development, and on the basis of its quality of life underpinned by effective usability of human and social capital as well as modern information and communication technologies (Turečková & Nevima, 2018). In this context, we deal with the territorial implementation of individual smart solutions which represent an innovative and working approach to developing solutions for various situations in an appropriate and socially positive way (Borsekova et al., 2017). Smart solutions must make cities more humane and not just technologically advanced (Slavík, 2017). This applies to the search for a suitable hospital navigation system that must be both economical and socially efficient, rational and acceptable to its visitors.

The aim of this article, based on theoretical and conceptual resources, is to provide a description of existing and innovative navigation systems in hospital buildings. This objective is expanded

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to include an analysis of indirect effects in particular, whether positive or negative, resulting from the respective navigation types. A desirable and appropriate type of navigation should be characterized by its acceptability for as many people as possible, its simplicity, economic and social efficiency and resistance to various risks to damage this type of navigation. The essence of navigation is (1) planning a way (ex-ante) to the desired location or (2) directing us (right now) to the final destination. These approaches to navigation can be solved separately or combined into one. In this paper, we will discuss navigation inside hospital buildings.

Hospitals are typically large, complex and dynamic evolving spaces, which are being regularly reconfigured and extended as operational needs shift and change, often resulting in a confusing, non-systematic layout (Li et al., 2015). That is why navigating in large hospitals is a challenging task (Anagnostopoulos et al., 2017). Given the diversity of hospital visitors and hospitals themselves, these hospital navigations must satisfy a range of individual needs of regular and occasional patients, staff, attendants and others, in the context of their cognitive and spatial abilities (Mollerup, 2009 or Allen et al., 1996). Appropriate navigation reduces time delays in finding a suitable place (surgery), reduces insecurity and stress (especially for the elderly), appropriately directs the distribution of large numbers of visitors in buildings into their individual parts, etc. This creates a number of positive externalities and effects that are desirable for society.

Common types of hospital navigation include reception at the entrance or personal assistance, (colored) guidelines on the floor or walls, wall panels with information, schematic plans of the building, signs assigned to individual medical departments, QR codes on the walls, special screens on glasses that show you the current direction (similar to 3D glasses), etc. GPS navigation is currently being promoted. There is in the preparation phase also individual navigation through direct identification of the person (patient), who then shows them the way to the surgery through the LCD screens placed in the corridors of the hospital.

2. METHODOLOGY AND THE USUAL TYPES OF NAVIGATING IN HOSPITALS

From the methodical point of view, the article is conceived on literature search, the secondary search of individual types of navigation and their short description, induction of indirect benefits and costs of individual types of navigation. As was written previously, emphasis will be placed on the analysis and comparison of indirect, explicit effects related to individual ways of navigation in hospitals. Knowledge of these effects, or their monetary quantification, is a key factor in assessing the effectiveness of the innovative solution and thus forms a specific input attribute in the decision-making process on implementation or rejection of such an implementation proposal. Emphasis is placed on the analysis and comparison of indirect, explicit effects related to individual ways of navigation in hospitals. Knowledge of these effects, or their monetary quantification, is a key factor in assessing the effectiveness of the innovative solution and thus forms a specific input attribute in the decision-making process on implementation or rejection of such an implementation proposal. The output will be clearly arranged into a table in a simple form so that it can be transferred to practice, especially as a basis for the preparation of a relevant CBA.

Many authors (Anagnostopoulos et al., 2017; Boonyachut et al., 2012; Devlin, 2014; Hughes & Brown, 2015; Pati et al., 2015 or Lee et al., 2014) for example mention the following types of commonly used navigation in hospital: (1) through an employee (reception, personal assistance); (2) schematic plants of the hospital (the map of the hospital complex is color-coded according to

individual departments); (3) wall banners with hospital department labels and the direction they are located; (4) guidelines on the floor or walls (usually color-coded by hospital department); (5) wall pictorial signs or direction signs to each the hospital department and (6) GPS navigation in the context of smartphone application. All of the hospital navigation options presented are shown in Figure 1 in the form of pictures.

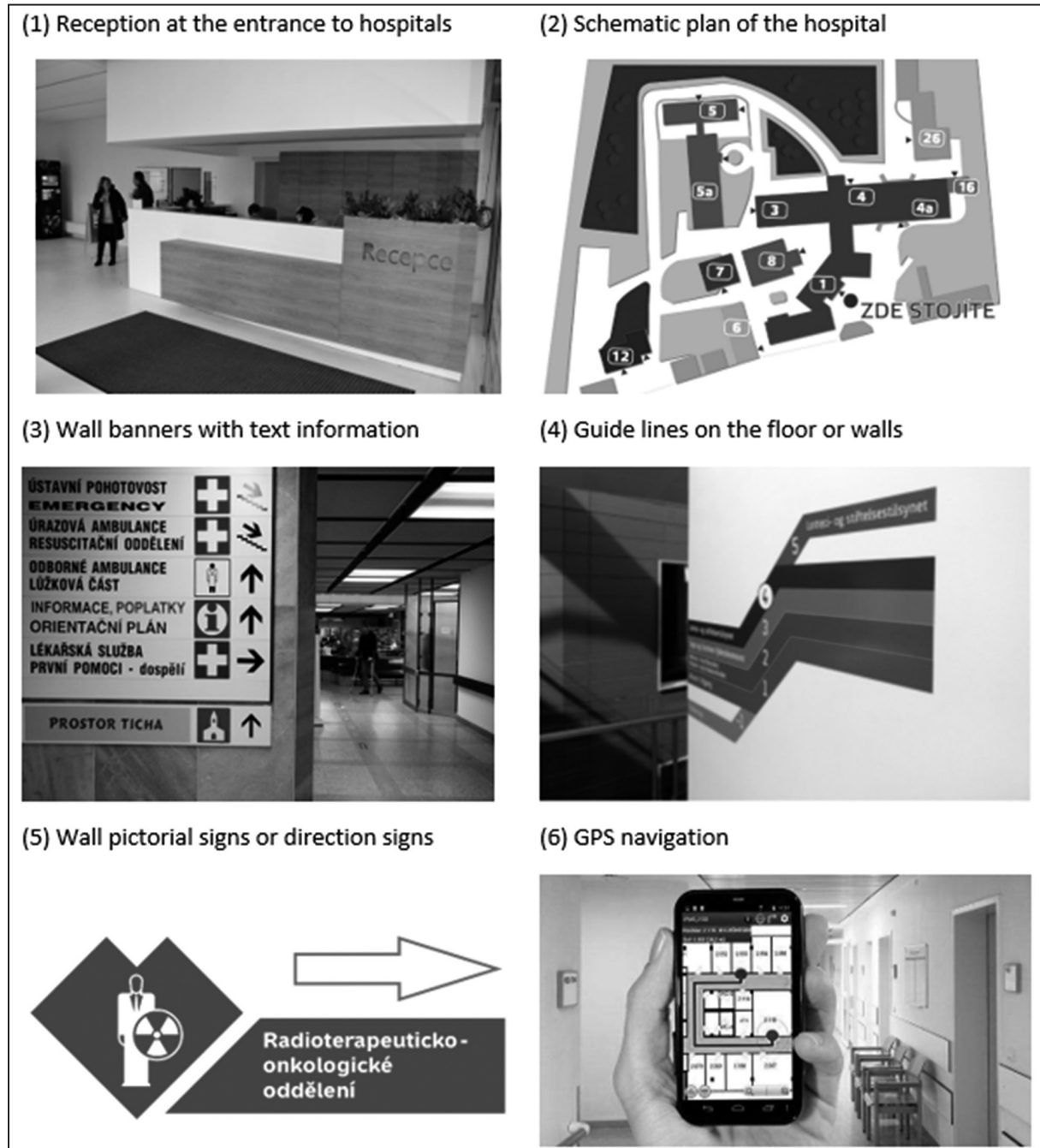


Figure 1. Selected types of navigation in hospital

Source: (1) <https://m.mb-net.cz>; (2) <https://nemocnicenovyjicin.agel.cz>; (3) <https://plzen.rozhlas.cz>; (4) <https://www.stavbaweb.cz> (modified) (5) <https://www.chrochtik.cz> (modified); (6) <https://phys.org>

Smart hospital navigation will be one that is cost-effective in terms of the first investment and other operating costs. Smart navigation must be clear and understandable at first glance, leaving no doubt about navigation to the target destination and thus satisfies most people. In the next

part of the paper, individual types of these navigations will be analyzed according to social indirect effects and acceptability for individual groups of people. It can already be said that smart navigation should be an appropriate combination of all the above-mentioned types in order to reflect the needs and health of different patient groups (children, young people, old people, low vision, poor mobility, people with “susceptible, sensitive” diseases (cancer patients, psychiatric visitors, incurable patients ...), etc.).

3. ANALYSIS OF SOCIAL INDIRECT EFFECTS OF SELECTED TYPES OF NAVIGATIONS IN HOSPITALS

At this point in the paper, we will try to summarize the benefits and costs of individual types of navigation used in hospitals based on the research of secondary sources and our own experience in the field of indirect effects.

The reception allows personal contact of the visitor with the employee who should have all the partial competencies to navigate the people in the hospital (especially the ability to explain the way simply and precisely) (Hughes & Brown, 2015). Personal form of communication is generally preferred by the elderly. The advantage is an immediate professional information service for visitors who can get more information than the localization of the department of surgery. This form of navigation entails the cost of paying for receptionists and, in the case of a large number of visitors, downtime. This form of navigation is inversely proportional to the explanatory skills of the receptionist and the complexity of the hospital complex.

Schematic plan is most often found at the entrance to the hospital. From this point of view, it is problematic to find your way to the required department. The visitor may be afraid that he will not remember the way. Usually, too, the plans are general, only schematic, with text explanations on the sides. Orientation in them can cause difficulties for some groups of the population (Devlin, 2014). Updating these schematic plans is also difficult and costly. Therefore, it is advisable to use these schematic plans only in combination with other navigation systems. Together with them, the schematic plans of the hospital premises can be evaluated positively as the initial information about the hospital's orientation.

Wall banners with text information are often found at the entrance to the hospital and are combined with wall (pictorial) direction signs on the walls in many places in the hospital (Rodrigues et al., 2019). Separate text banners can be found as confusing and the description of navigation could be inaccurate and simplified. Again, there is a problem with remembering the way. Text banners on the wall can be undesirable navigation for purblind visitors or some other group of patients who then have to ask for directions anyway. The way the memorability problem is solved by steady direction signs on the hospital walls. In this case, there is a possibility to overlook this marking or confusion with another department. For pictorial signs (symbols), the problem is the same as the risk of confusing images from different departments (Rousek & Hallbeck, 2011). There is always a risk of poor placement of signs at critical points in the hospital. On the other hand, this type of navigation and its possible adjustment is inexpensive.

Guide colored lines on the floors or walls are possible to compare to tourist signs (in the Czech Republic and some other countries). Each hospital ward is assigned by a unique color, the lines drawn are at the beginning (sometimes even during) accompanied by a textual designation of the ward (Rodrigues et al., 2019). This type of navigation continuously guides the hospital visi-

tor from the entrance hall to the desired department (just stick to the desired color and follow it). This type of marking is cheap, but if it is placed on the ground it needs to be renewed. The main problem in the use of colors can be the lack of consistency in their use (Rooke et al., 2009). This type of navigation is not suitable for color-blind (unless a specific texture is added to the color). Confusing may also be the use of too many color bars. Optimizing the number and choice of colors is crucial. The use of elevators may be confusing, where it is necessary to supplement the guidelines with another type of navigation.

GPS navigations in hospitals are dependent on the application of ICT to smart mobile phones (Anagnostopoulos et al.2017 or Marshall, 2017). At the same time, it is highly sensitive to GPS signals, which may be restricted in buildings. The use of GPS navigation also encounters the cognitive and technical skills of different groups of people, especially the older generation rejecting this type of navigation. This type of navigation is not intended for people without mobile device equipment. GPS navigation needs to be linked to the internal structure (map) of the hospital, so it is necessary to constantly update the mobile application of the hospital system. On the other hand, a suitable GPS navigation application can reflect the specific needs of the patients (wheelchair users, weak-sighted ...) and adapt the route to the ward (or voice navigation).

Table 1. Summary of indirect effects of individual types of hospital navigation

Type of navigation	Negatives	Positives
Reception (personal contact)	<ul style="list-style-type: none"> incompetent workers (downtime (queues), wrong explanation...) 	<ul style="list-style-type: none"> synergy of information the social benefits of personal contact
Schematic plan	<ul style="list-style-type: none"> the general design of the plans is only indicative (inaccurate in detail) concerns with remembering, uncertainty, asking, downtime 	<ul style="list-style-type: none"> as a complement to other navigation methods initial awareness of the disposition of hospital spaces
Wall banners with text information	<ul style="list-style-type: none"> possible text confusion the need for immediate memorization (uncertainty) verification of information 	<ul style="list-style-type: none"> a general overview of the hospital structure as a good complement to other navigation methods
Guide (colored) lines (floor, wall)	<ul style="list-style-type: none"> determining the appropriate number of color lines and choosing colors problems for color blind people and elevator using 	<ul style="list-style-type: none"> uninterrupted navigation simplicity for Czech citizens the traditional way of navigation in the terrain
Wall pictorial and direction signs	<ul style="list-style-type: none"> badly selected pictogram easy replacement of pictograms or direction signs oversight of signs inappropriate location of signs 	<ul style="list-style-type: none"> as a good complement to other navigation methods continuous navigation suitable pictogram replaces written text (foreign-language visitors)
GPS navigation	<ul style="list-style-type: none"> full dependence on ICT and availability of GPS signal continuous updating of the navigation mobile application 	<ul style="list-style-type: none"> direct and immediate navigation to the location full visitor autonomy

Source: Authors, 2020

Anagnostopoulos et al. (2017) in their study found out which types of navigation seem appropriate to respondents. Best turned out option with volunteers who help people in way-finding, then the colored lines on the floor and smart mobile applications offering location information. In other places, they were interactive screens, landmarks (photos or paintings) and signs. According to respondents, these means of localization should be improved the most.

4. CONCLUSION

A truly Smart City uses innovation to provide critical services to the resident in a cost-effective manner (McClellan, 2019). The Smart City concept is based on an active smart approach to dealing with any undesirable situation. The result of applying a Smart approach should thus be to make a smart decision and to find a smart and functional solution for a given problem). The Smart solution may not be wholly new but maybe an existing solution complemented by innovative features (Turečková & Nevima, 2019). Navigating around large hospitals is often a major source of anxiety, frustration, and stress for those visiting and working here (Hughes et al., 2015). It also has significant and direct “cost” implications in terms of missed appointments whilst also putting an overall strain on staff time and resources in guiding others (Martins & de Melo, 2014). In the case of our article, current and most frequently used possibilities of navigation within hospitals were analyzed in terms of their selected social effects. Now, based on the above analysis, we will try to design a smart solution that reflects the positive effects and eliminates the negative effects. This can be achieved by a suitable combination of partial navigation solutions.

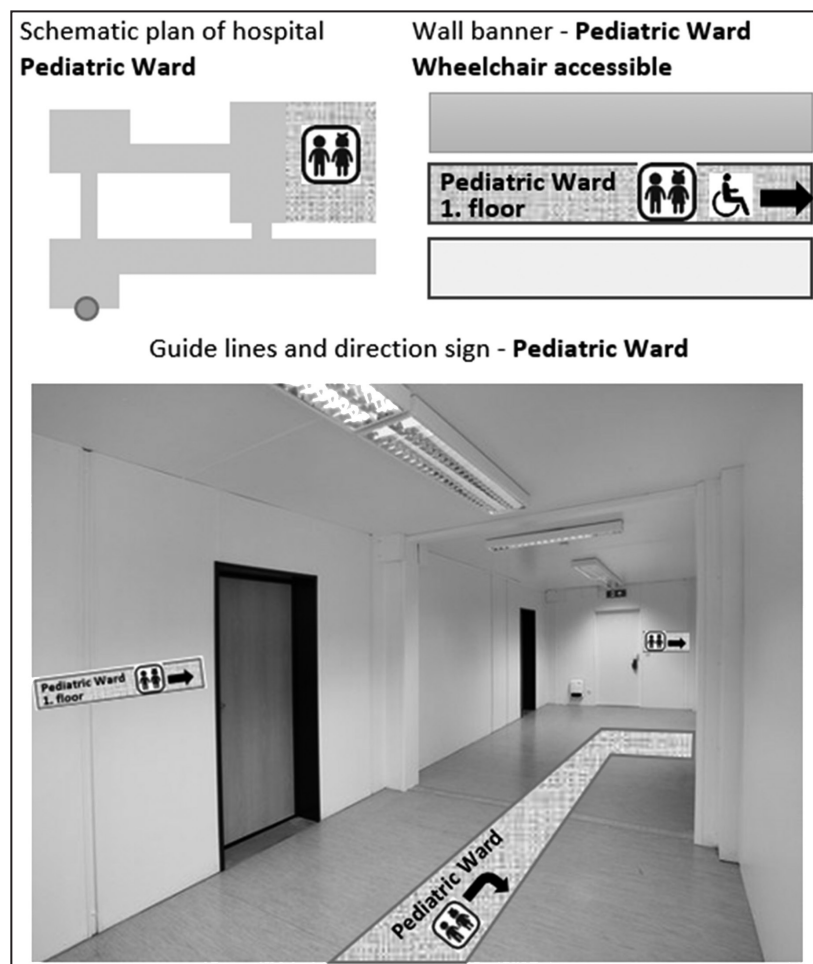


Figure 2. Proposed smart navigation in hospital

Source: Authors

Appropriate hospital navigation can combine a hospital scheme (plan) with wall text banners where each department will be represented by a unique color and pictogram (simple picture). The guidelines on the floor or walls or direction indicators on the walls will also be marked as well (color and pictogram) accompanied by a textual designation of the hospital department.

Such a navigation system combining color, text, pictogram and directional sign (including schematic plans for each department with the location where you are) is understandable to most visitors and, when sufficiently and appropriately applied in the hospital, allows visitors to navigate comfortably their destination. The navigation system can also be supplemented with a barrier-free access sign or signs indicating stairs or elevator. In addition to this navigation system, a reception can also be recommended to provide visitors with the assurance that they understand the hospital navigation system.

The use of ICT technologies, especially at present GPS navigation can be delivered as a complementary, independent system of hospital navigation. As technology advances and ICT literacy of people continue to grow, modern navigation systems based on the use of different ICT tools and technologies can be expected. The classic navigation in hospitals should then be maintained too. It has a parallel in tourist marking in our territory (Czech Republic), which began to use around 1884. Although GPS navigation, online maps, and various mobile applications have been established in tourism for many years, this traditional tourist marking is for its universality, simplicity, and permanency still the most wanted. Who would still like to look at a screen?

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