LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

SOCIETAL FACTORS INVOLVED ON RISK MITIGATION POLICY

Challenges to seismic retrofitting of hospital buildings

LISBOA • 2009

Delta Sousa e Silva
Assistente de Investigação, LNEC

Benigno E. Aguirre
Professor Catedrático, University of Delaware

Comunicação apresentada no *"International Seminar on Seismic Risk and Rehabilitation"*,
realizado na ilha do Faial, Açores, Julho, 2008

SILVA, Delta Sousa e
Socióloga, Mestre em Sociologia
Departamento de Edifícios

AGUIRRE, Benigno E.
Sociólogo, Doutor em Sociologia
Disaster Research Center (DRC)

Divisão de Divulgação Científica e Técnica
AV DO BRASIL 101 • 1700-066 LISBOA
e-e: livraria@lnec.pt
www.lnec.pt

Editor: LNEC

Colecção: Comunicações

Série: COM 142

1.ª edição: 2009

Tiragem: 100 exemplares

Descriptors: Hospital building / Seismic risk / Social problems / Building rehabilitation
Descritores: Edifício hospitalar / Risco sísmico / Problemas sociais / Reabilitação de edifícios

CDU 316.334.56:699.841
ISBN 978-972-49-2171-6

Societal Factors involved on Risk Mitigation Policy:
Challenges to seismic retrofitting of hospital buildings

ABSTRACT

This paper discusses the recurrent societal problems that emerge in the seismic risk mitigation policy process. It offers a definition of risk mitigation, and examines its application to earthquake threat, particularly the challenges to mitigation *adoption* and *implementation* processes. California (E.U.A) experience with the application of legislation (SB1953) mandating seismic structural and non structural retrofitting of hospital facilities illustrates these problems and also shows how stakeholders, who are supposed to act in accordance with the law, have adjusted to the new regulatory environment. This case is illustrative of how well-intended rules may fail in their applicability because of a failure in anticipating undesirable and unintended outcomes. It brings attention to the embeddedness of mitigation efforts on institutional processes, and the importance of taking into account the specificities of target-areas and organizations when investing on seismic safety rehabilitation and retrofitting.

Keywords: risk mitigation, public policies, California SB 1953 legislation

Factores sociais subjacentes uma política de mitigação do risco: Desafios que se colocam à readequação anti-sísmica de unidades hospitalares

RESUMO

Este artigo discute os problemas de ordem social que recorrentemente emergem na promoção de políticas de mitigação do risco sísmico. Propõe-se uma definição de mitigação do risco, aplicando-a ao caso da ameaça sísmica, e sistematizam-se os principais desafios que se colocam à adopção e implementação de políticas redução da vulnerabilidade sísmica. A experiência da California (E.U.A) na aplicação de um quadro legislativo (SB1953) apostado em promover a readequação estrutural e não estrutural de edifícios hospitalares pretende ser ilustrativo desses mesmos desafios. Neste artigo apresentam-se algumas das estratégias de ajustamento, protagonizadas pelos hospitais, de modo a agir em consonância com o novo regime de regras. Este caso de estudo é revelador de como regras bem intencionadas podem falhar, no terreno, devido à ausência de um esforço prévio de antecipação dos efeitos não-desejados de determinadas medidas. Por outro lado, procura-se, a partir da experiência da Califórnia, chamar a atenção para a importância da adequação de políticas desta natureza às especificidades das organizações a quem competirá a implementação de políticas de reabilitação e de readequação anti-sismica de edifícios.

Palavras-chave: mitigação do risco, políticas públicas, legislação SB 1953-Califórnia

ÍNDICE

Societal Factors involved on Risk Mitigation Policy:
Challenges to seismic retrofitting of hospital buildings

1. Introduction

This paper's aim is to discuss many of the non-technical and societal problems that emerge in risk mitigation policy processes associated with earthquakes. California experience with the adoption and implementation of policies to structurally retrofit buildings in hospital campuses is used to illustrate the challenges posed by seismic mitigation. On the basis of research carried out by the Disaster Research Center we present and discuss California experience with the implementation of SB1953 legislation, which is concerned with seismic structural and non structural retrofitting of hospitals' buildings. This experience illustrates how well-intended laws can result in inefficient outcomes when enacted and implemented without a thorough consideration of the interests of the public health institution in the state. We argue that risk mitigation is an inherent conflict-ridden, political activity and a process of social change. The challenges it poses to communities go beyond strictly technical ones to impact their social, economic and political arrangements. Mitigation will not occur if hazards are not widely perceived as having serious effects. However, beyond overcoming community apathy towards risk, other challenges related to the policy adoption and implementation of mitigation measures must be recognized. Mitigation effort requires the involvement of a large array of stakeholders, ranging from governments to private owners and community organizations that are part of the institutional networks of the society. The main challenge very seldom satisfied is to arrive at technical solutions that are viewed as acceptable and efficacious by these various stakeholders who are subject to their own private and public institutional interests. It requires a new conception of mitigation law. This paper has sections dedicated to a discussion of the risk mitigation concept, the stages underlying policies of risk mitigation, and the societal challenges associated with them. Afterwards, we review the results of the research on California experience of hospitals' retrofitting to highlight the main difficulties hospitals' administrators and staff experienced when trying to implement SB1953. In the conclusion we argue for the need to develop mitigation policies that would be subject to continuous review and adjustment as they go forward.

2. Defining risk mitigation

Human systems cope with environmental extremes through adaptive processes. These range from "doing nothing", and bear disaster impacts, to act pro-actively. Risk mitigation constitutes an example of acting pro-actively and concerns human action taken during routine day, with reference to future extremes, aimed at reducing vulnerability and disaster impacts.

The most common approaches of risk mitigation include hazard source control, community protection works, development control through land-use practices and building construction standards. Hazard source control involves action at the point of hazard generation. Protection works aim at reducing the impact of a hazard in a certain community and is typically illustrated by engineering devices for flood control such as dams, levees and seawalls (NRC, 2006). Land-use management seeks to control development in hazardous areas and is carried out through a large array of practices such as zoning regulations, setbacks and buffers, land acquisition, critical and public facilities policies, clustering of development in less hazardous areas, and restriction of types of construction (Olshanky et al, 2003; Berke et al, 1992). Finally, building construction standards aims at making structures less vulnerable to hazard agents, namely seismic forces. Such approach may take place through building standards for the construction of new buildings and facilities and retrofitting existing buildings and infrastructures. Some authors (e.g. Rossi et al, 1982) make a distinction between structural and nonstructural measures, with the first corresponding to hard engineering works, aimed at controlling the hazard agent and its impacts, and the second including a large array of practices, ranging from land-use planning to building construction standards and other actions focused on building components. These include a diversity of operations, such as securing room contents to walls in earthquake zones, reinforcing energy and water systems, communication systems and fire protection devices (Whitney et al, 2001). This typology is usually criticized due to its limited utility and ambiguity. The category “nonstructural measures” includes a large array of different sorts of actions and some of them imply engineering measures (NRC, in ibid).

In the specific case of earthquake threat, mitigation is commonly achieved through the investment on development control through land-use management, building codes for new construction and seismic rehabilitation. Any of these strategies requires expert knowledge, but it is misleading to envisage mitigation problem and its solution as exclusively technical. As Tierney (1993) posits, risk mitigation is socially structured and mainly a social activity. While hazard-resistant building designs may prove to be feasible in the laboratory and in technical forums, they may be found inadequate in the real world and encounter difficulties of political, economic and cultural order. Although possible through informal and voluntary processes, mitigation measures typically occur through political means in the form of public policies and tools aimed at getting individuals, social groups and entire communities to engage in behavior which would protect them and their property in future earthquakes. They are processes of planned change (Dynes, 1991) which involve experts, but requires the participation of other actors: governments and public officials, residents and property owners, developers, land speculators and real estate representatives, financial institutions and mortgage guarantors, insurers and reinsurers, as well as the organizations operating in the physical space in which mitigation programs operate, and which have their own institutional requirements and goals. Each of these stakeholders may bring to the mitigation process their own view of the problem, and some of them usually feel as “losers,” or “loss experience parties” of the policy that is implemented.

Urban seismic rehabilitation and building retrofitting poses particular challenges and difficulties, but also advantages. Buildings strengthening can produce benefits at the human level, by preventing human losses and injuries; at the economic level, by protecting private property and investments as well as minimizing and shortening business interruption period in the aftermath of an earthquake; at the level of disaster response, due to its potential to lower demands in terms of search and rescue, medical assistance, emergency shelter and re-housing; and at the level of post-disaster recovery, because it creates more conditions for the quick restoration of normal activities, assuring an easier re-establishment of psychological well-being in the damaged communities. Critical facilities, such as hospitals and medical care services, are of major importance due to their irreplaceable role in providing immediate assistance to the community in the aftermath of a disaster. This fact is at the basis of some governments' particular attention to the retrofitting of these facilities. On the other hand, priority to the rehabilitation of these facilities and public buildings, e.g. schools and government agencies, is commonly envisaged as a way of persuading private stakeholders to take seismic mitigation seriously and act in favor of it. However, as we shall see bellow through California experience with SB1953, well intended initiatives of mandating critical facilities retrofit do not escape political, administrative and economic difficulties, which, if not anticipated and avoided, may cause inefficiency and policy discredit.

2.1 Stages of risk mitigation

Risk mitigation policies are commonly conceptualized as a four-stage process, which include the previous *recognition* of the hazard as a problem, the *adoption* of a mitigation strategy, followed by its *implementation*, and the *evaluation* of its effectiveness. *Adoption* is mainly an "iterative phase" where alternative adjustments are considered, risk assessments are pursued, choices are made and the initial commitment with a particular strategy is assumed. The *implementation* phase corresponds to the process of application of established mitigation measures. Regarding to seismic rehabilitation, *adoption* would correspond to the process of enactment of codes for existing buildings while *implementation* would refer to the whole process of applying the codes to the target-buildings and areas (Lindell, 1997). It is important to highlight that this four-stage model serves solely analytical purposes. In the real world, it is difficult to isolate each phase, due to its complexity and to the continuous feedbacks, pauses and adjustments that occur.

2.1.1 Recognition of the problem

Risk social awareness is the precursor for any action. In other words, for mitigation to occur, risk must be socially recognized as a problem, with potential for personal and community losses, but in relation to which it is possible to do something to prevent (Dynes, 1991; Alesh et al, 2006). Although the priority given to hazards varies according to geographic, social, economic and political contexts, there is scientific evidence showing that hazards tend to have low social salience and that people tend to systematically underestimate the risks they face, to underutilize preventive measures, and to depend on governments´ emergency response and disaster relief (Turner et al, 1986; Lindell, in ibid). Further, studies also indicate that social risk perceptions usually have little relationship with geophysical nature of risk. People in high hazard areas often give low priority to risk reduction and mitigation. According to Stallings (1995), low salience usually given to natural hazards is a function of the cultural practice of differentiating between natural and man-made risks, where the first are unquestionably attributed to the “outside” environment and the second to human action. Although questioned on some scientific forums, this dichotomy is deeply rooted on public-at-large visions of the world and commands decision-making in the public arena. Earthquakes are almost exclusively envisaged as acts of nature. Such tendency uncouples risk magnitude and vulnerability from human agency and undermines any possibility for “grass-roots” mobilization to act-proactively against earthquake threat (Stallings, 1994). Thus, “changing the rules” on the seismic safety domain implies the social construction of earthquake threat as a byproduct of human agency.

Governments are key-actors on any effort of mitigation. Protective action at the individual level, although crucial, has a limited scope when taken in isolation and pursued in the absence of public policy processes aimed at influencing land-use management and patterns of building construction and retrofitting. The above-mentioned naturalistic view tends to generate political quiescence towards the earthquake threat. On the other hand, it is difficult to convince decision-makers to devote time and attention to irregular and low-probability problems when their agenda is full of competing and more pressing demands. Further, seismic safety is typically a domain with short-term economic costs and no immediate benefits. Decision-makers tend to work with short-term horizons and in accordance with “electoral cycles”. Such logic is incompatible with risk mitigation processes, which take time and usually don’t produce immediate benefits (Alesh and Petak, 1986).

2.1.2 Adoption, implementation and evaluation stages

The enactment and implementation of hazard mitigation is dependent of policy options that incorporate technical solutions viewed as acceptable and efficacious by non-technical decision-makers and stakeholders. As mentioned earlier, mitigation is more than a technical exercise. It is a process of planned change and planned social conflict that requires the involvement of different groups and inevitably puts in confrontation different sets of problems, priorities, interests and values. Further, in the specific case of seismic rehabilitation, it is important to take into account that each building has its own vulnerability profile, not only in structural terms but also in terms of patterns of occupancy, functionality, and socioeconomic characteristics of the occupants.

Petak (1983) distinguishes three types of policy stakeholder groups: mitigation involved parties, loss experiencing parties, and mitigation constraining parties. The first are those who, due to their position and role, must take decisions to mitigate natural hazards or are technically involved on achieving appropriate mitigation solutions (e.g. policy makers, experts, government planners and building officials). Given their role in public arena, they fight for the value of public safety, defend the benefits of seismic mitigation and rehabilitation and are, in some contexts, moved by the motivation of having to avoid future legal liabilities in case of future disaster. Loss experiencing parties include those groups who are exposed to risk and may suffer from future disaster losses, but also will inevitably be confronted with concrete social and economic costs of mitigation measures (e.g. owners, tenants, business and services operators). Constraining mitigation parties correspond to those groups who envisage mitigation policy as constraining factor of their interests, aims and projects (e.g. land speculators and developers, real-estate operators, opponents to government regulation).

It is very difficult for mitigation adoption and implementation process to escape social conflict of, at least, two major set of values. We refer, on the one hand, to the centrality of public safety values and, on the other, to the cost burdens that it may create. It is important to assure that seismic safety effort does not endanger the fulfillment of other also important community needs and does not create unfair situations by allocating the cost burdens on some stakeholders or on socially vulnerable groups (e.g. the poor social households and the elderly). Seismic rehabilitation is among the most costly mitigation operations. Apart from direct costs related with engineering assessments and works, such effort can have indirect costs related to the eventual needs of residents' temporary re-housing, business interruption and economic loss. To further complicate the issue, benefits of seismic rehabilitation may seem abstract to some groups. As referred above, people often discount low-probability/high consequence events and may not be predisposed to appreciate the effectiveness and long-term benefits of improved seismic performance of buldings.

Consequently, no policy development process escapes from some level of conflict. In order to achieve sufficient agreement, and arrive to technical solutions that are acceptable by non-technical stakeholders, it is important to opt by a strategy that creates real opportunities of debate and negotiation and that involve people and organizations in the community. Before decision-makers arrive to the final mitigation program design, criteria underlying vulnerability assessments, seismic retrofitting priorities, policy timetables and mitigation costs should be clearly presented to stakeholders, debated, and agreed upon. Social and economic impacts resulting from different policy alternatives should be carefully assessed before any decision is made and enacted. Seismic safety is an arena unfavorable to mandatory and top-down policies. The most appropriate implementation approach is the one that combines steadiness, in the sense that "rules of the game are to be followed", with some opportunities to trade-offs, e.g. extension of timetables to accomplish most costly measures in exchange of the short-term freezing of certain rules. Furthermore, the fact that seismic mitigation programs are adopted does not mean that they will be effectively implemented or that they bring about the intended results. Well-intended decisions may produce undesirable and unintended outcomes. The perpetuation of inefficacious rules endangers the credibility of the policy and demobilizes even those who are supporters of the program. A way of avoiding this risk is to follow a process of policy implementation which would activate mechanisms of periodical evaluation, and, if necessary, make adjustments and changes to the law.

3. Seismic retrofitting of critical facilities: the case of California hospitals buildings

Hospitals are decisive units of response in case of disaster. In California, public concern with hospitals structural integrity emerged in the aftermath of the 1971 San Fernando earthquake, where disaster experience prompted the enactment of state legislature (Alfred E. Alquist Seismic Safety Act, 1972) requiring specific safety standards for new hospital facilities and structural and non structural retrofitting of existing buildings. In the 1971 San Fernando earthquake (Los Angeles, California), 50 of the 64 deaths that occurred were due to hospital building collapse, and 4 hospitals with structural failure were closed. Subsequent earthquakes of significance in California, occurring in 1989 (Loma Prieta) and 1994 (Northridge), did result in hospital damage. However, no one was killed directly by damaged hospital structures. The same was true of the Whittier Narrows event, which did not result in hospital damage (personal correspondence with Professor Carl H. Schultz, March 14, 2008). A study conducted in 1989 by the Office of Statewide Health Planning and Development revealed that the majority (83%) of the state's hospitals did not comply with the above-mentioned legislature. Furthermore, some of these hospitals needed to improve on their nonstructural earthquake standards (Whitney et. al, 2001). Northridge earthquake occurred in 1994, and caused an estimated $3 billion in damage to Southern California hospitals. It reinforced the importance of giving special attention to this issue. New legislation was enacted. Known as Senate Bill 1953 (SB1953), this legislation requires hospitals facilities, including those built before 1973, to be brought up to contemporary structural and non-structural seismic standards (Holmes, 2002; Alesch et al. 2001). On the basis of technical assessments, buildings were rated on a scale ranging from

SPC-1, the lowest level corresponding to facilities which pose a significant risk of collapse, to SPC-5, the highest safety category for buildings in full compliance with the structural and non-structural provisions of the law. They were assumed to be able to continue to provide services to the public following a strong earthquake. This legislation covers approximately 2,507 buildings, 975 of which were classified as being at SPC-1, on 475 hospital campuses (California Heathcare Foundation, 2007). Beginning in January of 2002, SB1953 required hospital facilities to achieve seismic safety in two stages: January 2008, where hospitals would have to meet at least the SPC-2 level[1]; and January 2030, where the SPC-4 level must be achieved. Non-structural measures were to be achieved separately and in an earlier date.

The 2008 deadline arrived and SB1953 structural rehabilitation requirements were not met by most if not all the hospitals in the state. Instead, efforts are being made by healthcare organizations to modify the legislation. Some acute care hospitals were able to obtain an extension to 2013, by showing that, if their health services were closed, their service area would suffer a diminished health care capacity. It is worth mention that, all along this time, efforts have been made by health organizations to improve on the non-structural seismic requirements of he law (White et. al, in ibid). Surprisingly, when SB1953 was firstly proposed, hospital organizations and associations seemed supportive of the requirements. However, once enacted, hospitals attitudes varied widely (Alesh et al., 2006), primarily when it became clear that there would be no public funding and that the majority of hospitals lacked the financial resources--- more than 40 percent of hospitals would need to close their doors. Presently the implementation of structural retrofitting requirements is far from being satisfactory. Policy improvements on the domain require a good understanding of the reasons underlying the difficulties of SB1953 implementation.

3.1. Hospital seismic mitigation study

California was selected for a Disaster Research Center´ study conducted in 2002 on the matter of emergency preparedness and risk mitigation of health care organizations (Aguirre et al, 2005). Apart from California (high seismic risk area), this research had as target-regions Tennessee (moderate seismic risk area) and New York metropolitan area (low risk level). Hospitals in each region were selected according to previously established criteria[2] and the

---

1 Buildings classified as SPC-2 correspond to those that don't present risks of structural collapse, but are presumed to suffer from problems of functionality following a strong earthquake.

2 Criteria underlying hospitals' selection were as follows: i) hospital with acute-care facilities with emergency rooms or trauma centers; ii) diversity in terms of size of the hospital organization (small facility=less than 150 beds; medium

final sample comprehended 13 hospital facilities, four in California, five in Tennessee and four in New York. This study's results are preliminary, and would need to be replicated using a more representative sample of hospitals in the states included in the study. The 13 focus groups included 76 respondents and at least one representative from each of the following four groups of staff dealing with crises and disasters: hospital administration, physicians, nursing, and engineers. Several of the focus groups included high-ranking members of the hospital administration. Respondents represented a diverse range of professions. Most were active members of their hospital's safety committee and had been involved in safety issues and crisis preparedness policies in their hospitals, embracing continuous quality improvement. This selectivity should be kept in mind in the interpretation of the results. Respondents are not a random sample of the hospital staff but have a strong interest on preparedness and mitigation activities. While we cannot claim that their concerns for these issues represent all hospital staff, nevertheless they are ideally situated to comment on the larger patterns of organizational life of interest to us. The focus group interviews consisted of open-ended questions on hospital experiences and perceptions of internal and external risks, emergency plans and programs, the importance for emergency response and mitigation of operational units in the hospitals, internal physical systems such as heating, and external lifeline systems such as transportation routes, and various emergency preparedness measures.

3.2 California and the SB1953 legislation

3.2.1 Competing demands and the problem of retrofitting costs

The research revealed the existence of differentiated judgements concerning seismic priorities and hospitals' demands. While legislation and seismic safety advocates, e.g. lawmakers and mobilized professional associations, put high emphasis on structural seismic readiness of the existing physical plants, for hospital administrators and staff such demand was only a partial determinant and needed to be balanced with vital demands related to what constitutes, on their view, the central mission of the organization, namely their ability to deliver patient care on a daily basis. Further, hospitals' compliance with SB1953 structural retrofitting measures was

---

size facility=151 to 300 beds; large size facilities=301 or more); iii) diversity in terms of ownership (government-owned and operated facilities, for-profit organizations, not-for-profit organizations).; iv) in each of the three regions selected for the study, hospitals were matched to represent hospitals in both major metropolitan cities and in smaller cities in the same counties, so as to be able to study the impact of city ordinances and building codes on hospital mitigation measures. Twenty-nine health care facilities satisfied these selection criteria, and thirteen agreed to participate on the research. The population list of hospitals in these regions comes from the American Hospital Association's (AHA) Guide to the Health Care Field, an annual directory of hospitals and health-related organizations in the United States, which provided basic background information for hospitals, including bed count, type of ownership, and a list of facilities within hospitals such as trauma centers and maternity wards.

envisaged as excessively costly and, consequently, an effort that would jeopardize the fulfilment of health care demands.

Respondents had different idea about priorities. Several administrators acknowledged that, based on the experience of Northridge earthquake, implementation of non-structural requirements appeared for them as relevant since in the aftermath of that disaster, hospitals' performance suffered from non-structural damage (e.g. shortage of potable water, abundance of water broken pipes and water leaks) and not from structural failures. In the words of two respondents:

> "It all depends on the type of damage that we would sustain and our internal capabilities. We may not have sustained any structural damage but our capabilities could be low, so that we would be in a situation where a disaster hitting us would only compound the issue, but that may have nothing to do with the infrastructure."

> "An 6.0 earthquake, our building probably would not stand. It would not make any difference if it could withstand an 8.0. You may have the walls standing but what is inside may not be. The Japanese are probably the most earthquake conscious nation in the world and yet we found out that the generators for the hospitals in Kobe were all cooled by city water so they lost all of their generators because the city water interrupted during the most recent massive earthquake. The generators in the hospitals were useless. So you can do all of this stuff and there are very often hidden problems."

Also noted by other studies (see Alesh et al., op cit.; Whitney et. al., op cit), seismic risk was socially recognized as a problem in relation to which precautions had to be made. Hospital stakeholders acknowledged the importance of investing on this domain, but without jeopardizing other priorities and the survival of their health care organization.

3.2.2 The problem of uncertainty

In addiction to the problem of having competing demands, respondents questioned the appropriateness of having short-term very concrete costs to guarantee the structural safety in a future scenario which, in their view, was covered by ambiguity and uncertainty. Hospital administrators and staff realized that the outcomes of investing in many of the seismic structural retrofitting measures on existing buildings are often uncertain. There are a number of reasons for this belief. They envisage the technology to determine the magnitude and location of the earthquake hazard as well as the best way to mitigate its effects as evolving, often depending on the imperfect knowledge of multiple disciplines. In the words of one respondent:

> "Seismic technology is still a mystery. Until the Northridge earthquake they talked about shaking this way and that way. That baby went this other way, and it totally changed structural engineering techniques… So how do you engineer it? Who engineers it? What are the appropriate seismic retrofit techniques? And how should they be done? There are many differences in terms of how people are thinking about these issues, and it creates difficulties for us."

They also understand that their vulnerability from earthquakes is not solely a matter of having seismically unsound buildings, but results in part from the specific characteristics of the hazard that may materialize, itself a difficult matter to discern and plan for. Under these circumstances, they make decisions not with the aim of "maximizing" the safety investments benefits, but rather to satisfactorily do what they judge is possible to do within their resource availability (Simon, 1982; see also Kahneman and Tversky, 1979).

3.2.3 Building technical complexities

When decisions involve the seismic structural retrofitting of existing buildings, full compliance with seismic building codes was generally not observed among the hospitals in this study. The opposite is true for the construction of new hospital buildings, for they adhered to all structural seismic building code regulations. In the words of one respondent:

> "When the new parking garage was built, which has a lot of different levels of concrete, it was built according to the new seismic code. It has expansion joints, and whatever else it needed. Nowadays we are building new operating room suites, and you can see some of the seismic building codes that they are implementing."
>
> Another example:
>
> "The trauma center was a newly constructed, free-standing building. We have in it state of the art seismic elements such as phase isolators. Whatever the industry had out at that particular time is on it. The facility could withstand a certain magnitude earthquake."

Importantly, it is not always possible for hospital administrators and staff to determine whether and to what extent their existing buildings are in compliance. Many of the hospitals in this study had multiple buildings at different levels of seismic readiness, which made it difficult to develop a comprehensive assessment of the extent to which they met seismic code exigencies, as the following quote illustrates:

> "We have one building now that is seismic. Everything else is in various stages, so that we go from poor to bare minimum maybe in terms of seismic readiness. One of our building was built in 1942, the other was built about 1944, a third building was done in the late 1950s, a fourth was built in 1981, a fifth was done in 1991, a sixth was built in 1994, and that is the one that is seismic compliant. The other buildings are not seismic, so that we don't have Z-bracing on the structural parts. However, we do have locks on pipes and other things that are suspended, and they got the teetered cables so they will not fall on people's heads. The non-structural outlets have been strengthened. The 1994 building was built from scratch, that way it has Z-bracing throughout."

Another respondent in another facility expresses a similar difficulty:

> "Is there a seismic code? Yes and no. There is one code in the new facilities and then there are the old facilities built on different codes. Our counterparts in the city, when they were inspected, were made to do certain things, such as raising shelving and some other things that we have never been required to do when we have submitted plans. It has to do with the age of the building and its location. This building is supposed to be "earthquake resistant. The label comes from the building code established in the early 1970s. It is supposed to have some flex in the structure. This was one of the first hospitals built in the city to meet the code guidelines related to earthquake specifications."

Often buildings built under different building codes are connected among themselves. Their physical adjacency and the networks of communication, utilities and critical systems existing among them diffuse their respective differential seismic vulnerability throughout the system of buildings in a hospital campus:

> "We have ten buildings. One was built in 1927. And attached to it, I mean as part of the 1927 building, there is a 1952 building. They tend to separate. They do come apart. They came apart in the last earthquake. Then we have a fourth building that is this building. Then we have the fifth building. Then we have the conference center. The fifth building is also connected to the 1927 building. We have the ICU building that is connected to this building and was built in 1989. We

> also have a parking garage building. We also have other buildings done in the early 1920s. These buildings are primarily on a one square block, except for two buildings that actually are across the street."

None of the buildings in this complex have been evaluated for their seismic worthiness. The diffusion of vulnerability among buildings is also apparent in the following response from another focus group:

> "The general view around here is that the high school building will sit down like a pancake when it folds. One of our buildings would probably remain standing. It is a fairly stiff compact building, a lot of mass for its type, so that it would probably do fairly well. Everything else would crumble, and the problem is that as they crumble they will impact other structures, for all of our buildings are connected by breezeways and utilities. It would not be pretty. The general citywide thinking is that the hospital is on the earthquake fault. If it shakes, it shakes, and there is nothing that you can do. The soil that we are on right here will become like quicksand, and we will be gone. We would have to rebuild under the new seismic codes."

The physical links among buildings built under different building codes at time create permanent incompatibilities in their structures to which hospital personnel and patients must adjust[2].

3.2.4 Regulatory complexities

Another aspect mentioned by the administrators and staff was the existence of multiple regulations, building codes, and enforcement agencies monitoring the seismic worthiness of the buildings of hospitals, and at times it is not clear what building code is applicable and what regulatory agency is involved with what specific type of hospital function, and what specific segment of the built environment. This reality more complexity to the process, but paradoxically seemed to have "opened the door" for negotiation. Whether or not hospitals were in compliance with the seismic components of the building code was to some extent a process

---

2 It results in the constant monitoring of the relative safety of various buildings, known in some hospitals as "environmental rounds" in which different people from different departments in the hospitals check for safety and the environment, such as fire doors, elevators, to make sure that things are working as expected.

of negotiation. In these negotiations, architects and engineers often helped hospitals determine how best to seismically retrofit their facilities, and what they needed to attend to in the building codes. In the words of one hospital respondent:

> "We have an architect that is real familiar with our facility. He actually attends all the meetings of the state agency with jurisdiction over the new building code, actually sits in on those meetings on the planning and designing aspects. Then from there the only other people who are involved at this time are the actual structural engineers. We just sent out an RFP to try to get information from three different engineering firms about the cost of doing our entire compliance plan. They will be probably the only other people who will be pulled in. The rest of the work is handled in house by our staff."

Some of the hospitals had their own planning and design groups.

> "Drew up the specific areas we want altered. They make plans that are code compliant; they are responsible for making sure we adhere to the appropriate building codes. A building expediter is involved to make sure that we do it right. They will decide if the sprinkler system can be grand-fathered, or if a particular piece of property has to be upgraded. They are responsible for making sure we adhere to the appropriate building codes, such as rehabilitating or retrofitting non-structural elements to ensure they will not fail."

It was in this context that some hospital administrators and staff felt some flexibility in the process of responding to earthquake-related structural retrofitting code requirements for existing buildings.

3.2.5 Hospitals' strategies of adjustment

Although there are difficulties underlying the implementation of SB1953, hospital stakeholders are active and made their own adjustment. The research revealed that hospitals tried to find an efficacious way of investing money to protect existing facilities against earthquakes. Over time they have developed four general strategies to deal with the structural demands of seismic building codes.

Non-structural retrofitting. As already mentioned, there was a strong perception that non-structural seismic retrofitting was relevant and more cost effective. Most of these non-structural retrofitting efforts involved the strengthening of *systems* in existing buildings rather than retrofitting entire buildings. Other changes were signs showing the proper direction for exits, replacement of generators to make them code compliant, restraints for piping systems, ceilings and light fixtures that are seismically anchored to the building, new decontamination areas, and new doors.

> “Do you bring the building up to the current code, regardless of its age? We run into more of that with sprinklers, because our buildings do not have this safety feature, so if we do any major renovations we are going to have to add sprinklers and those types of things (emphasis added). We're not a fully fire-sprinkle building. We haven't been required by code, but we are, on our own initiative, going to sprinkle the entire facility to meet code over the next couple of years (emphasis added).”

Remodel of spaces´ functionality. Another mode of adjustment to the demands for seismic structural retrofitting of existing hospital buildings is moving functional units around different buildings in a hospital complex, as the following examples indicate,

> “If you are remodeling about 40 percent of an area of the hospital, then the code department will require you to bring everything else up to standards. A fine example would be where we were going to put in the Radiology Department. We found that if we built it in a certain area then we had to bring the entire radiology department up to code, because of the amount of space that was involved. But fortunately when we expanded the hospital and built a section of it, the radiology department was expanded, so part of the radiology department was inspected and brought up to code at that time. What we had to do was redesign the program, and in that way we avoided at that time the additional expense of bringing the entire radiology department back into code.”

Outsourcing. Another adjustment was the outsourcing (Kirkman-Liff et al., 1997) of certain activities and elimination of certain hospital parts.

Timing. In some rare occasions, another way to get around the problem of stiffer regulations is to have building elements inspected prior to the effective dates of new seismic codes.

In sum, hospitals are constantly doing non-structural changes to improve the earthquake-related safety of their buildings. However, they do not attempt to modify all of the structural components of existing buildings that new seismic building codes prescribe. It is not entirely because they lack knowledge of the importance of seismic retrofitting (Russell et al., 1996) or because inspectors lack education (EERI, 1996). Rather, it is primarily because of the uncertainties associated with the decision, the tremendous financial expenses of doing so, the multiple dimensions of implementing safety in hospitals, and the complex regulatory environment in which they operate. They spend what they must to ensure a reasonable degree of occupant safety, while building new structures to fully comply with the new seismic codes.

4. Conclusion

Mitigation is commonly understood as actions intended to forestall known dangers and to render them as harmless as possible. In the case of earthquake threat, mitigation is mainly achieved though processes of land-use control and building standards for new construction, building rehabilitation and retrofitting. Throughout this paper, we tried to demonstrate how inappropriate it is to envisage mitigation as essentially a technical goal. It is mainly a social activity that takes place in a wide variety of socioeconomic and political contexts and implies change in the way communities perceive risk and act towards land and built environment. Experts are obviously irreplaceable stakeholders on such process of change, but no real mitigation will occur if it does not assure the involvement of all those actors that, due to their interests, influence the course of action, e.g. governments, public organizations officials, property owners, tenants, private organizations representatives and land developers. Each of these stakeholders will bring to the policy arena their own view of the problem, their own values and interests, and their own ideas about the most appropriate solutions. Typically, such views are divergent, as it concerns mitigation worthiness and priority, making conflict inevitable. Thus, the main challenge is not only the achievement of the best technical solution of land-use control or seismic building rehabilitation, but also the consideration of the political conflicts and institutional interests expressed in them.

The case study on California implementation process of SB1953 legislation is illustrative of a set of measures that, although technically relevant and well-intended, lacked social feasibility. As noted, there was not lack of social awareness towards earthquake threat, but with it came the conviction that SB1953, if applied, would jeopardize hospitals' future capacity to deliver health care. Seismic structural retrofitting measures would have much greater chance of being implemented in California and elsewhere if they would incorporate hospitals' stakeholders' views, and the usual way that they make decisions (a matter we have documented elsewhere, Aguirre et al., 2005). Ignoring these matters, and assuming that the values and relevancies of engineering disciplines and other professional settings can be used to write the law and then make hospitals adopt such measures, are bound to be much less efficient. It would be more effective to integrate multiple interests and to provide room for negotiation both in the writing of laws and their implementation, finding out what hospital administrators and staff think will work about retrofitting their buildings, and taking into considerations what they can afford to spend.

Resources are finite and the threat of earthquakes is real even if the readiness of hospital buildings to withstand these risks is inadequate. What is needed is optimizing systems for existing hospital buildings that alleviate their seismic structural and non structural vulnerabilities and do not have devastating economic impacts on so many of the hospitals. Granted that different constituencies have different interests and favor different solutions (Alesch and Petak, 2001), it is still the case that there is a need for integrative, comprehensive perspectives bringing about solutions during the law adoption stage that incorporate the concerns of the major players in the policy setting process. We need to look deeper to create a "Hubble Telescope" effect that incorporate in the adoption and implementation of the law, the interests of the institutions that are impacted by it. It is not enough to try to protect the public without understanding and minimizing the unintended consequences that are created by this political action. This means a new vision of mitigation law that would incorporate its complexity by allowing change and adjustment in light of experience. It will involve a "flexible" law that would place priority in incorporating the experiences of the institutions that are required to change and the short and long term effects of the legislation.

5. References

Aguirre, B. E., Dynes, R.R., James K., Connell, R. (2005) - Institutional Resilience and Disaster Planning for New Hazards: Insights from Hospitals. *Journal of Homeland Security and Emergency Management*, vol. 2 (2).

Alesch, D. J., Petak, W. J. (2006) - Guidance for Seismic Safety Advocates: Formulating and Evaluating Policy Alternatives. MCEER, Unpublished manuscript.

Alesch, D., and Petak, W. (2001) - The Troubled Road From Adoption to Implementation: Hospital Seismic Retrofit in California. Unpublished manuscript.

Alesch, D., Petak, W. (1986) – *The Politics and Economics of Earthquake Hazard Mitigation: unreinforced masonry buildings in Southern California*. Institute of Behavioural Science, University of Colorado, Boulder.

Auf der Heide, E. (2000) - Disaster Response. Principles of Preparation and Coordination. Atlanta: Center for Excellence in Disaster Management and Humanitarian Assistance, Online edition, http//www.coe-dmha.org/dr/flash.htm

Berke, P., Beatley, T. (1992) - *Planning for Earthquakes, Risk, Politics, and Policy*. Johns Hopkins University Press, Baltimore MD.

California Healthcare Foundation. (2007) - Seismic Safety: Will California´s Hospitals be Ready for the Next Big Quake? January 19.

Dauner, D. (2006) - Hospital seismic safety: the mother of all unfunded mandates. *Capitol Weekly*, January 19.

Dynes, R. (1998) - Coming to Terms with Community Disasters. E. L. Quarantelli, (ed.), *What is a Disaster?*, Routledge, New York.

Dynes, R. R. (1991) - Social Science Research on Earthquake Hazard Mitigation: Relevance for Policy and Practice". International Symposium on Building Technology and Earthquake Hazard Mitigation, March 25-29, Kunming, Yunnan, People's Republic of China.

Farley, J. (2000) - *Earthquake Fears, Predictions, and Preparations in Mid-America*. Southern Illinois University Press. Carbondale.

Gamson, W., Fireman B., Steven R. (1982) - *Encounters with Unjust Authority.* Dorsey Press Homewood, Illinois.

Holmes, W. T. (2002) - Background and History of the Seismic Program In California. Unpublished manuscript, available from the DRC Special Collection.

Kahneman and Tversky (1979) - Prospect Theory, Econometrica, 47: 263-292.

Kennedy, W. (1966) - Some Preliminary Observations on a Hospital Response to the Jackson, Mississippi Tornado of March 3, 1966. Columbus, Ohio: Disaster Research Center Working, Paper nº 6.

Kirkmann-Liff, B., Huijsmn R., Van Der Grinten T., Brink G. (2000) - Hospital Adaptation to Risk Bearing: Managerial Implications of Changes in Purchaser-Provider Contracting. *Health Policy*, vol. 39: 207-233.

Lincoln, Y. S., Guba, E. G. (1985) - *Naturalistic Inquiry*. Sage, Newbury Park, CA., USA.

Lindell, M. (ed) (1997) - Adoption and Implementation of Hazard Adjustments. *International Journal of Mass Emergencies and Disasters*, Special Issue, vol. 15, nº3, November: 323-435.

Meade, C., Kulick J., (2007) - SB1953 and the Challenge of Hospital Seismic Safety in California. Prepared for the California Health Foundation, a RAND Report.

Meade, C., Kulick, J., and Hillestad R. (2002) - Estimating the Compliance Costs for California SB 1953. Prepared for the California Health Foundation, a RAND Report.

Mileti, D.S. (2003) Disasters by Design, Reassessment of Natural Hazards in the United States. John Henry Press, Washington DC.

Morgan, G. (1986) - Images of Organization. Sage, New York.

Nigg, Joanne M. (2000) - Social, Economic and Policy Issues Associated with Health Care Facilities, in G. C. Lee, M. Ettouney, M. Grigoriu, J. Hauer, J. Nigg, Proceedings of the MCEER Workshop for Seismic Hazard Mitigation of Health Care Facilities. Buffalo, New York: University of Buffalo, State University of New York.

NRC (2006) - Facing Hazards and Disasters, Understanding Human Dimensions. The national Academy Press, Washington DC.

Olshanky R., and Kartez, J. (2003) – “Managing land use to build resilience”, in R. Burby (ed.) Cooperating with nature: confronting natural hazards with land-use planning for sustainable communities. Joseph Henry Press, Washington DC.

PETAK, W. J. (1983) - “Natural hazard management: governmental problems and responsibilities”, paper presented at the Annual Conference of the American Society of Public Administration, April 16-19, Los Angeles, USA.

Quarantelli, E. L. (1970) – “The Community General Hospital. Its Immediate Problems in Disasters”, *American Behavioral Scientist*, vol. 13 (3): 380-391.

Quarantelli, E. L. (1987) – “What Should We Study? Questions and Suggestions for Researchers About the Concept of Disasters”, *International Journal of Mass Emergencies and Disasters*, vol. 5,(1): 7-32.

Quarantelli, E. L. (1994) - Sociological Research Agenda for the Future: Theoretical, Methodological and Empirical Issues. Newark, Delaware: Disaster Research Center Preliminary Paper nº 228.

Rossi, P., Wright, J. and Weber-Burdin, E. (1982) - Natural hazards and Public Choice, the State and Local Politics of Hazard Mitigation. Academic Press, New York.

Ruef, M., Scott R., (1998) – “A Multidimensional Model of Organizational Legitimacy: Hospital Survival in Changing Institutional Environments”, *Administrative Science Quarterly*, vol. 43 (June): 877-904.

Russell, J. E., Johnson R. J., Olson R. A., Yee R. T. (1996) - Construction Quality, Education, and Seismic Safety. Earthquake Engineering Research Institute, Buffalo, New York.

Schultz, C. H. (2008) – “The Hospital Response After an Earthquake”, Professor of Emergency Medicine, Disaster Medical Services UC Irvine School of Medicine. Unpublished manuscript.

Shattuck Hammond Partners (2001) – “Financial Health of California’s Hospitals”, paper submitted to California Health Care Foundation.

Simon, Herbert A. (1982) Models of Bounded Rationality, Volume 1 and 2, MIT Press, Cambridge.

Stallings, R. (1970) - “Hospital Adaptations to Disaster: Flow Models of Intensive Technologies”, *Human Organization*, vol. 29 (4): 294-302.

Stallings, R. (1994) – “Constructing risk: a sociological theory of the earthquake threat”, paper presented at the 13th World Congress of Sociology, Bielefeld, Germany.

Stallings, R. (1996) - *Promoting Risk: Constructing the Earthquake Threat*. Aldine de Gruyter, New York.

Stallings, Robert A. (1968) - Structural Change in Professional Organizations: A Hospital’s Response to Disaster. Columbus, Ohio: MA Thesis, The Ohio State University.

Tierney, K. (1993) – “Socio-economic aspects of hazard mitigation”, paper presented at the Research Seminar on Socio-economic Aspects of Disaster in Central America, January 21-23, San Jose, Costa Rica.

Turner, R., Nigg, J., and Paz, D. (1986) Waiting for Disaster: Earthquake Watch in California. University of California Press, Berkeley.

Whitney, D., A. Dickerson, M. Lindell. (2001) Nonstructural Seismic Preparedness of Southern California Hospitals. *Earthquake Spectra* 17 (1): 153-172.

Annex. Slides of the communication

Societal Factors involved on Risk Mitigation Policy: Challenges to Seismic Retrofitting of Hospital Buildings

Delta Sousa e Silva
Laboratório Nacional de Engenharia Civil, Núcleo de Ecologia Social, Portugal

Benigno E. Aguirre
Disaster Research Center, University of Delaware, USA

Structure of the Presentation

1. **Risk mitigation: what is it?**
   - a definition and common approaches;
   - advantages;
   - challenges;
   - stages of mitigation policies.

2. **Seismic retrofitting of critical facilities: the case of California hospital buildings**
   - The DRC study;
   - Antecedents and SB1953 Legislation;
   - Some results on policy implementation.

1

Risk mitigation: what is it?

A definition and common approaches

> mitigation | acting pro-actively

***Human action** taken during routine day, with reference to hypothetical future extremes, aimed at **reducing vulnerability** towards risk and disaster impacts.*

> Common approaches

- Hazard source control;
- Community protection works;
- Land-use management;
- Building construction standards;
- Building rehabilitation and retrofitting.

zoning regulations;
Setbacks & buffers;
Land acquisition;
Cluster of development;
Restriction towards types of construction.

Risk mitigation: social advantages of investment

> Economic level
- Protection of private property & investment;
- Reduction of business interruption, in the aftermath of disaster.

> Disaster response
- Lower demands in terms of search & rescue, medical assistance, emergency shelter and re-housing.

> Post-disaster recovery
- Quick restoration of normal activities;
- Easier re-establishment of psychological well-being in damaged communities.

Risk mitigation: challenges

> Mitigation: a process of planned change (Dynes, 1991)
- Getting individuals and communities to engage in behavior which would protect them and their property in future earthquakes;
- It goes beyond experts and implies the involvement of other stakeholders (ex. policy makers, property owners, residents);
- It puts into confrontation different interests and values, namely the value of "public safety" and "costs";
- Rarely escapes from conflict.

> Mitigation is envisaged as mainly a social activity.

Risk mitigation policies: a four-stage process

> **Recognition of the problem**

- Risk awareness as the precursor of any action;
- Risk must be recognized as a social problem.

> **Adoption**

- Risk assessment & alternative adjustments;
- Technical solutions envisaged as **acceptable** by non-technical's stakeholders;
- an iterative process.

> **Implementation**

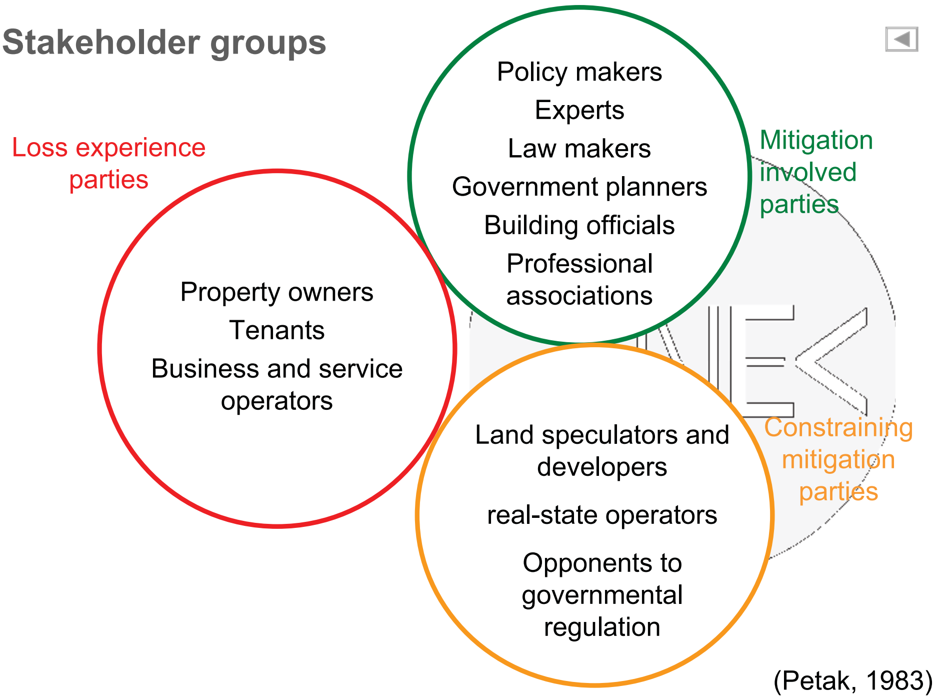
- Steadiness ("rules are to be followed"), with opportunities for trade-offs and negotiation.

> **evaluation**

- Impacts assessment and, if necessary, make adjustments.

recognition — **adoption** — **implementation** — **evaluation**

Stakeholder groups



(Petak, 1983)

2

Seismic retrofitting of critical facilities: the case of California hospital buildings

The DRC study

> **Study conducted in 2002** (exploratory study)

> **Aim**
- Knowledge of emergency preparedness and risk mitigation practices and efforts on health care organizations;

> **Target-areas**
- California (4 units), Tennessee (5 units), New York (4 units);

> **Method**
- Focus groups in each health care unit;
- Participants: staff implicated in hospital administration; physicians; nursing and engineers [all with responsabilities on safety issues]

Antecedents and SB1953 legislation

> **1971 San Fernando earthquake**
- Human losses in hospital facilities prompts regulation (Alfred E. Alquist Seismic Safety Act, 1972);

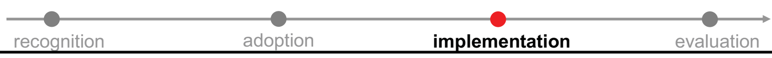
> **1989 Loma Prieta & 1994 Northridge earthquake**
- Study: 83% of hospitals did not comply with the law;
- Northridge: $ 3 billion in damage in Southern California hospitals;
- New legislation: Senate Bill 1953.

> **SB 1953 legislation**
- Technical assessments classified State hospitals according to a scale, ranging from SPC-1 "facilities that pose significant risk" to SPC-5 "highest safety category";
- 975 buildings classified as SPC-1 in a total of 2,507 covered by the legislation

Some results on policy implementation

> **Seismic safety priority *versus* hospital demands**
- Legislation put high emphasis on seismic safety and hospital administrators perceived it as only partially determinant;
- Compliance with SB1953 viewed as excessively costly; could jeopardize other demands related with hospitals mission.

> **The problem of uncertainty**
- Short-tem costs to guarantee safety in face of a future scenario perceived as covered by ambiguity and uncertainty;
- Technology as always evolving, imperfect knowledge and discordance among seismic experts seen as misleading.



Some results on policy implementation

> **Building technical complexities**

- Legislation blind to particularities of target-health care campuses;
- Each hospital with multiple buildings, built in different times and under different seismic safety regulations: What to do? Which should be the priorities and most appropriate actions?

> **Regulatory complexities**

- Multiple regulations and multiple enforcement and monitoring agencies;
- Which is the right code to act upon? Who are the right agency and representatives to talk with?
- Paradox: “open the door to negotiation between parts”.

recognition — adoption — **implementation** — evaluation

Some results on policy implementation

> **Hospitals’ strategies of adjustment**

- Not to maximize seismic safety investments and balance with other hospital investments;
- Investment on non-structural retrofitting;
- Remodel of spaces’ functionality;
- Outsourcing of some services.

recognition — adoption — **implementation** — evaluation