

En route to a knowledge based Building Regulation and Control that interlinks societal requirements, scientific knowledge, education and building practice

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Abstract:

The regulatory system in the Netherlands was one of the first performance based systems. Successful as it was, there are still many problems with its practical application. Research by the Dutch ERB indicates that most of these can be attributed to a poorly functioning knowledge system in which regulations should be embedded.

Building regulations can be considered as a manifestation of knowledge and political decisions that enable practitioners to design and build such that minimal key societal needs will be met. It enables also owners and users to demonstrate that in the existing stock minimal key requirements are fulfilled. They are part of a knowledge cycle that involves all actors in the construction value chain. The actual goal of regulations is essentially to protect the public (general) interests of the end user and/or final owner. The end user / owner, however not part of the system, is remarkably enough legally liable in the case of default.

With this understanding as a basis, it is possible to reconsider structure and content of the regulatory system. Instead of being a tool for disputes, it should be a purposeful tool for actors in the construction value chain. This paper presents an innovative approach to the regulatory system. It comprises three levels for plan evaluation or judging of existing works. Processes and responsibilities are reconsidered, as well as education and roles of actors. The envisioned new approach stipulates better and more economical buildings, avoidance of unnecessary summons, and substantial cost savings in control.

Keywords:

building regulations, enforcement, knowledge system

1 Introduction

The Dutch Building Decree has been under discussion for decades. Excellent building rules and regulations form an important, even an essential link between building practice and society, aiming primarily at the availability of safe, healthy, usable and sustainable buildings. How effective building rules and regulations are, depends largely on their practical applicability, costs and the extent in which they provide for building innovations.

With its Building Decree 1992 Dutch legislation took an important first step en route to renewal of the system. As opposed to the traditional building regulations, the Building Decree does not prescribe in detail how to build, but indicates, by means of performance requirements, which objectives a construction or construction unit will have to meet. This system leaves space for the application of fresh, innovative solutions.

Now, almost twenty years later, it is time to evaluate the concept. Although the Building Decree has emerged to be successful in many aspects, various problems have also been noted which appear to be structural in origin.

The Expertisecentrum Regelgeving Bouw (Expert centre Regulations in Building-ERB) published its first, overall analysis in 2008 (Scholten *et al.*, 2008). One of its conclusions was that the end user – who, as the owner of a building, is legally accountable for it to meet the rules and regulations set – is represented too feebly in the building process, and often does not even play any role at all in the decision-making. Because of this, the end user could become the loser. As a result ERB assigned a group of experts and scientists to further investigate this issue and to come with a solution to this undesirable situation.

Other conclusions were that in the public and private sectors two separate courses of knowledge development took place, and that the building regulations in their present form insufficiently warrant that societal objectives are realised.

2 The present system

As a reaction to the abominably bad housing of city immigrants in the second half of the 19th century The Netherlands created the Housing Act in 1901. From then on the municipalities were responsible for the drawing up and enforcement of regulations in the form of local building codes. In the 20s and 30s of the 20th century, the Housing Act advanced the construction of good - and still attractive - dwellings.

After World War II building contractors began to operate more and more nationwide. They were confronted by masses of different and inconsistent local regulations. In order to be able to rationalise the building process, countrywide uniformity was required. In the first instance the answer were the Modelbouwverordening (the Model Building Bylaw), issued by the Vereniging Nederlandse Gemeenten (the Association of Dutch Municipalities). Because many municipalities stuck to their own building regulations, the call for countrywide uniform legislation became increasingly louder.

In 1982 the Lubbers-1 cabinet took the initiative that finally resulted in the 1992 Building Decree. The Housing Act determined that from then on municipalities, fire brigades and utility companies were no longer allowed to issue regulations supplementary to or deviating from the Building Decree.

This first Building Decree had a completely different structure of directives from what people were used to. In the old system, the building regulations described specific solutions to many regularly occurring construction problems; innovative solutions were not allowed. As the Building Decree starts from the performance, required of complete buildings, constructors could from then on apply both standard and new, equivalent – or better - solutions.

Between 1992 and 1998 the government worked on the second round of the Building Decree which was never enforced. In the year 2003, the presentation form of the Building Decree was changed at the request of the market: the so-called table's legislation. However, the Dutch government simultaneously introduced a new modelling principle of works which did not link up with the experience of either the construction partners or citizens.

Since its publication in 1991, the Building Decree has been changed 29 times.

The Building Decree does not cover the whole spectrum of regulations relevant to building. For fire safe use the Decree on fire safe use of structures holds. For the demolition and the use of a building, municipalities still determine the contents of the regulations by local building bylaw. For specific buildings and safe and healthy work, specialised ministries published their own technical regulations.

Besides these, EU regulations for construction products were introduced, due to the free movement of goods.

In order to reduce the burden of too many regulations and organisational fragmentation the Dutch government recently decided to opt for four important measures:

(a) one 'environmental counter' for the dealing with 'environmental' related permits (the Wabo = General Physical Environmental Rights Act).

- (b) bundle any knowledge at the enforcement level by combining the responsible local services at regional level; on the advice of the Mans Committee (Report Committee Mans, 2008).
- (c) organise the fire departments regionally (Wet op de veiligheidsregio's = Act on Safety Regions).
- (d) skip 25 per cent of the content of the Building Decree, 'deregulation', and combine: the Building Decree 2003, the Decree on fire safe use of structures, the demolition regulations and other works relates regulations of the building bylaws and the Besluit aanvullende regels veiligheid wegtunnels (BARVW) = supplementary rules and regulations on the safety of tunnels, in the Building Decree 2012; intended to become in force on January 1st, 2012. The Dekker Committee (2008) advised to research whether - a substantial part of - preventive public enforcement of the building regulations could be evaded in case the private sector would take responsibility for compliance (Report Committee Dekker, 2008)

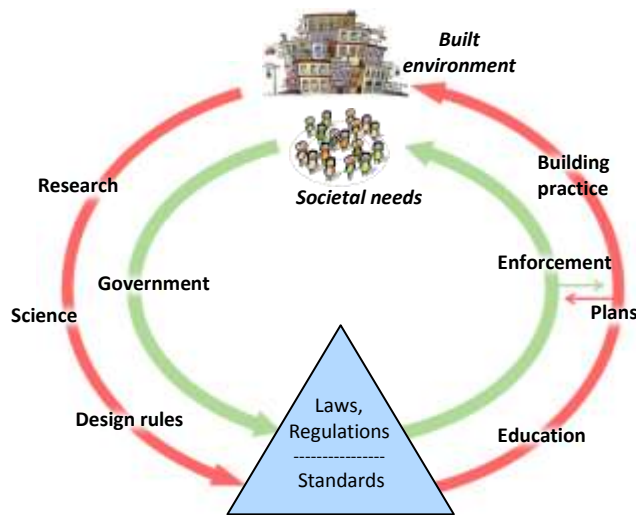
3 A necessary review of the system

The four recent measures are administrative and organisational answers to problems that are rooted deeper. Both, the public legislation and privately developed system of Standards form part of a knowledge system we need in order to realise and manage safe, healthy and sustainable buildings. That system must therefore function properly, which is not the case at present. Regulation becomes the more effective, the better it complies with this knowledge system. In other words: everybody involved in building and its management, must be able to properly understand, interpret and apply the regulations.

This knowledge should also lead to possible adaptations and the development of new regulations. Of course, these regulations should comply with the practice of design, construction and use. Lessons from practice should in turn lead to research and improved regulation. So, attention must be paid to the transfer of knowledge as well as to the restructuring of the regulations and the way in which regulation is affected.

3.1 The cycle of knowledge

The skill of designing and constructing good and reliable buildings is rooted in building science. This in its turn has largely developed empirically and is continually developed further. With a view to practical applications, scientific knowledge has been incorporated in design regulations, governmental rules and regulations and Standards. We may assume that buildings are sufficiently safe, healthy and sustainable when architects adhere to these regulations. Naturally, the same holds good for owners and users when managing and running their real estate. Should they not do so, we ought to change the regulations or stimulate people's adherence to the regulations. Occasionally, or in case of technological innovations, people should be able to deviate from the details in the regulations without necessarily endangering safety, health or sustainability. We have depicted the process outlined here as a circle of knowledge (see figure 1):



The *public* learning track (green): societal requirements are translated into rules and regulations through legislation, enforced according to public law by means of a licensing system, general terms and conditions, or sanctions recorded in the Housing Act, *Gemeentewet* (Municipalities Act) and the *Algemene wet Bestuursrecht* (provisions of administrative law); The *private* learning track (red) runs from research and science, through technical specifications and known solutions which are transferred in training programs, leading to professional practice. Some of these specifications and agreements have been laid down in Standards and assessment guidelines.

Figure 1. Knowledge circle
(Source: Scholten *et al.*, 2010)

Building regulations combine the two tracks to become a crossroads. Knowledge of Standards and their background is also essential for enforcement, and knowledge of rules and regulations is just as important for education and training programs. On the basis of the ideal model we are able to clearly illustrate the practice related hitches.

Figure 2 charts these hitches.

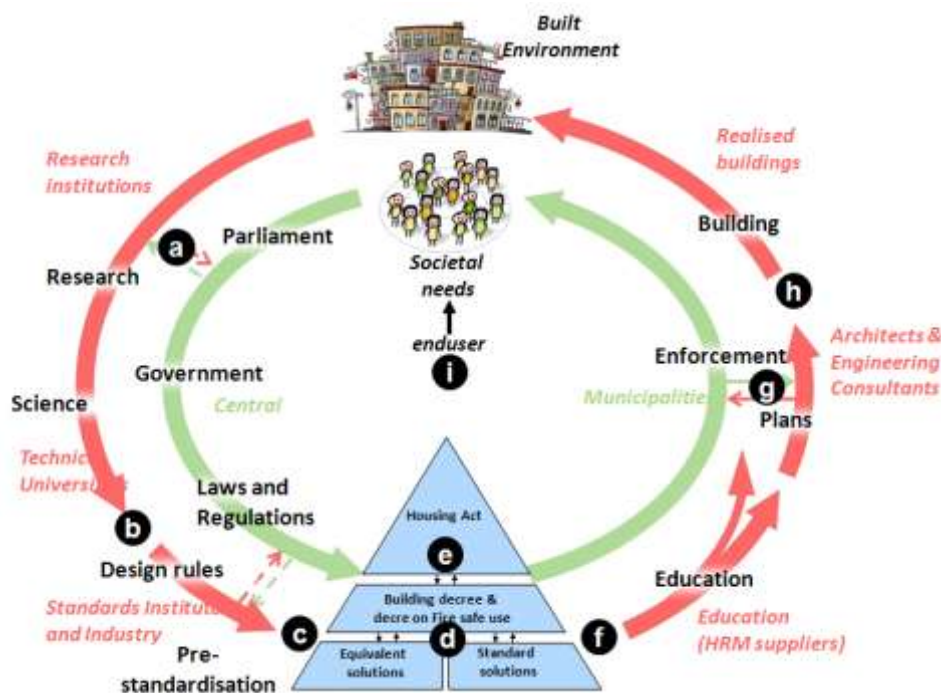


Figure 2. Hitches in the knowledge circle
(Source: Scholten *et al.*, 2010)

The first general problem is that the various actors in the private-law circle of learning work totally independently from each other. Universities, research institutes, schools for professional training, commissioning clients, designers, engineering consultants, building contractors, fitters, suppliers and consumer representatives, they all adhere their own policies, focusing specifically on their direct self-interests, and without much mutual coherence.

The next problem is caused by both a highly fragmented sector and the fact that not a single party individually obtains a competitive advantage from investing in the development of communication systems and therefore does not do so, however these systems are necessary to structure and improve mutual understanding in such a fragmented sector. Centralised communication systems are no-one's priority, and no 'central market superintendent' exists who could organise this.

And then there are other factors. We refer to the characters in the black circles of figure 2.

In order to make public-law rules and regulations and private-law agreements match, the two learning tracks on the left-hand side should be linked up with each other. At present there is no interaction whatsoever.

Standardisation must be based on research. The performance requirements must be based on measurement, determination or calculation methods. At present, unfortunately, many terms and conditions, and Standards are insufficiently founded by science. Due to the lack of proper financing, universities have little interest in the methodology and modeling necessary to formulate rules and regulations. The large technological institutions such as TNO (Netherlands Organization for Applied Scientific Research) largely depend on occasional commissions from the government and industries. This is the reason why they miss the long-term stamina necessary for the development of scientifically sound rules and regulations or Standards.

The knowledge on which the development of regulations and Standards is based has been insufficiently recorded and managed in the present system. After the successful completion of a regulatory project, everybody should be able to easily find the relevant background information with a view to an unambiguous interpretation, and support of the equivalence of possible, fresh solutions. Now, this knowledge seems to ebb away to such an extent that even the responsible bodies themselves do not always understand their regulations.

Individual private-law regulations, such as Standards, have been drawn up based on different disciplinary backgrounds, for instance: by constructors, experts in fire safety, and those in building physics or materials specialists; so these regulations do not match nicely. One result is a differing and inconsistent use of language. As the Building Decree (2003) refers to such regulations, unavoidable inconsistencies develop in legislation. The legislator's language use is not that of the standardisation commissions, while neither speak the language of the man on the building site (shop floor). The performance approach requires a level of abstract thinking which is not used on the shop floor; specialists with secondary education only understand problems by means of practical solutions. Would regulation be consistent and in shop floor language, the correct application of regulations would improve greatly.

The scope of application of building regulations should probably be extended. According to the original Housing Act, building rules and regulations were meant for the safety and health of the users of a building. Later, as an effect of these, regulations were added with a view to its usability and energy efficiency, later followed by accessibility and sustainability. Up to now, economic and cultural aspects and the prevention of criminality have been included only to a small degree. However, the regulations which have to promote the well-being of construction and aid-workers, such as firemen, have been laid down in the *Arbowet* (Law on Conditions at the Workplace); one can only find them implicitly in building regulations. Although the construction industry is one of the most dangerous, unhealthy and energy-consuming economic sectors. Presently, the building regulations pay very little attention to maintenance, renovation, and demolition. Surely, a building application or process should not only meet the building regulations, but also satisfy the *Warenwet*, (the Commodities Act: elevators and appliances), the *Wet milieubeheer* (Environmental Management Act), the *Kernenergiewet* (Nuclear Power Act: ionisation alarm), *Politiewet* (Police Act), *Archiefwet* (Records Act) and the *Law on Conditions at the Workplace*. With such complexity it is not surprising that people experience regulations related stress.

Rules and regulations only form a minor part of the curricula in secondary and tertiary professional education and universities. This creates an important lacuna in knowledge both within industries and law enforcement organizations of the government. It seems as if people no longer see how closely the administrative and building laws as well as technical regulations are connected.

Preventive assessment governed by public law is done only on the design stage of a building. So, one cannot even be sure that buildings realized actually comply with the relevant regulations. In today's building processes the end user, often the owner (to be) of a building, hardly plays a role. As the end users often are parties differing from the commissioners of buildings, their individual interests will generally be insufficiently represented according to private-law in the design and construction stages, so they will have to be able to rely on the public rules and regulations to sufficiently protect their interests. Many commissioners completely ignore all kinds of aspects that, for a society, are desirable and beneficial in the long run – think of the accessibility of buildings for persons with functional limitations, or the adaptability to various purposes of a building. If these requirements have been carefully dealt with in their design and construction, the layout of buildings will need to be converted less often, they will have a lower risk of vacancy, and early demolition due to their being unfit for purpose, will be their fate less often. The only way in which to realise this societal interest is for the government to list minimum regulations and enforce them.

4 A suggestion for improvement

Starting point is the enforcement of regulations whose societal usefulness have been proven. To diminish the burden of overregulation we can classify building plans on three different levels of argumentation per assessment aspect.

A first level is meant for easy assessment of *'standard solutions'*. We assume that possibly 80% of the building plans or existing buildings are or consist mainly of *'standard solutions'*.

The middle level more or less resembles the present Building Decree 2003 that focuses on performance.

The third level we propose, concerns building works in which unconventional and innovative solutions are to be implemented, using a probabilistic approach.

Should an applicant and the law enforcement organisation differ in opinion on whether a proposal meets the level of the standard solutions or the level of the ordinary assessment according to the performance requirements of the Building Decree, the third level would then provide the possibility of assessment according to the societal objectives regarding safety, health, usefulness, energy efficiency and sustainability. In that way discussions as regards technical content need not end in legal disputes.

For many people the introduction of these two new levels will substantially diminish the overregulation burden. At the levels of building and standard solutions assessment of the existing stock, one could then implement the greatly simplified regulations instead of those of the Building Decree 2003. While, at the third level, one can judge innovations according to societal objectives which present regulation does not provide for.

It is in no-one's interest to enforce regulations that are understood insufficiently. The supplements suggested greatly increase the practical usefulness of the regulations and they enhance the legislator's actual objective - the enforcement of safety, health, usefulness, energy efficiency and sustainability. That is why regulation is linked with objectives. The guarding of different, but coherent, assessment levels can thus be solved methodically.

We propose also to improve the process of securing regulation related knowledge. Assessment of building plans by local authorities contributes far too little to this end. Together with all those involved in the building process - from science, knowledge institutes, education, architects and engineering consultants, to and including the actual builders and the real estate sector - we must try and form a secure chain of knowledge with properly linked up sub processes. Only with a properly functioning knowledge system can we rely on the building sector to realise of its own accord the societal objectives which we may expect from it.

Procedural innovations are required. We need to attune the three assessment levels. The accepted standard solutions will be assessed according to the performance requirements as laid down in the second category and the question whether the performance requirements themselves meet the

objectives set, is answered by means of the risks approach which we will apply in the third category.

The elements which the three levels have in common, we have to establish at a generic level: objectives, risks models, user models, functional models and performance requirements.

The general structure of rules and regulations as presented below, in figure 3, has been depicted in the form of a grey triangle. This part of the structure ensures that the system remains consistent, also when societal objectives change and renewals are introduced. The parts relevant to applicants and assessors are in blue.

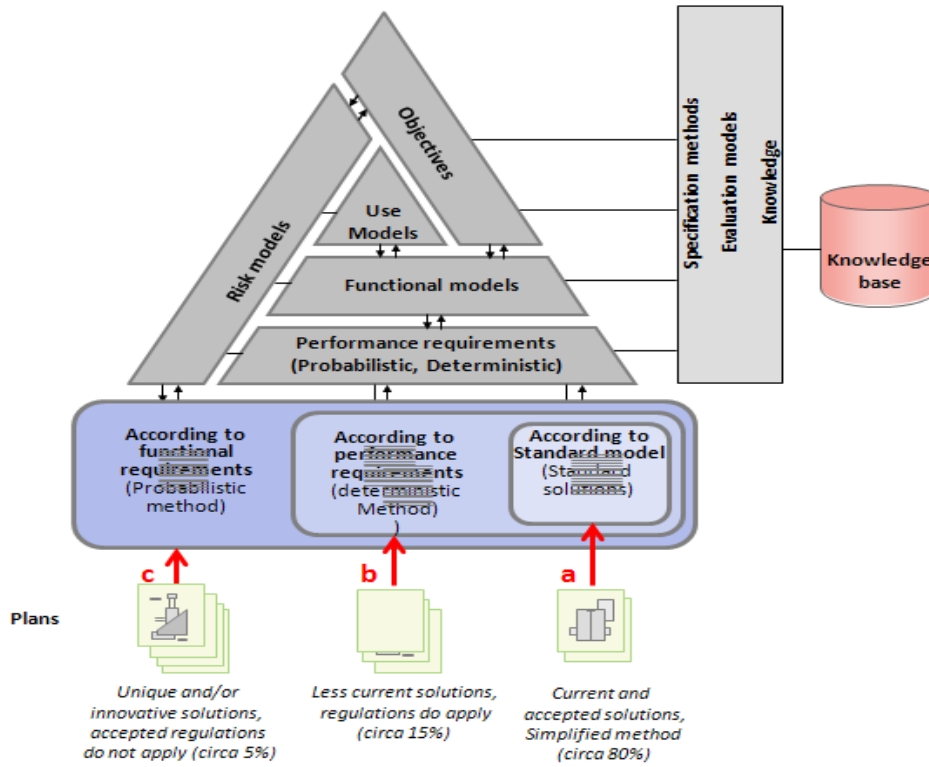


Figure 3. Vision on a durable anchoring of development of building regulations
(Source: Scholten *et al*, 2010)

Table 1. Explanation of captions used in figure 3
(Source: Scholten et al., 2010)

<p><i>Objectives.</i> Regulations must follow from a single coherent system of societal objectives. It is best to record these in a separate part of the regulatory system.</p> <p><i>Risks models.</i> Absolute guaranties for safety, health and sustainability cannot be given. Objectives always deal with <i>possibilities</i> and <i>risks</i>. They deal with the possibility of collapse, the risk of permanent physical injury or death, and the possibility of environmental damage. The present regulations often provide strict limit values for these possibilities and risks. Does exceeding these limit values immediately lead to unsafe and unhealthy situations or limited sustainability? Depending on varying circumstances or the use expected, a building may still, in an acceptable measure, meet the objectives laid down.</p> <p>That is why we will again have to standardize the whole system of regulations, standards and limit values according to the objectives by means of risks models and theory of probability. These models must become an integral part of the regulatory system. This too would greatly simplify regulation.</p> <p><i>User models.</i> We can only translate objectives into specifications for buildings if we also know how these are going to be used and who their end users will be. Models are necessary because of the variation of use in practice. That is why there is a need for realistic rules and regulations <i>user models</i>. By projecting these user models onto the model of a building, in terms of floors, working spaces and partitioning elements, we can then list functional and performance requirements.</p> <p><i>Functional and performance requirements.</i> Functional requirements describe the requirements of a building in a functional sense. The performance requirements we set for a building and its parts depend on their function and use.</p> <p><i>Modifiability.</i> Naturally, the rules and regulations system reacts to ever changing societal opinions. In the past decade, for instance terrorism, climate change and sustainability took top positions in agendas. Undoubtedly, new requirements and objectives will be added in the coming decades which cannot be foreseen for the moment. One should be able to change the rules and regulations as easily as possible, with minimum economic effects for users and real estate managers, while retaining previously acquired rights.</p> <p><i>Knowledge.</i> Many rules are clear-cut. But it is not always clear why certain rules exist or why others <i>don't</i>, or why specific terms are used. Often, the persons involved have stored this background knowledge in their minds, but it is not at all or hardly available to third parties. That is why this knowledge has to be publicly recorded so everybody will be able to properly interpret and apply them.</p>
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Methodical aspects also deserve attention. One can formulate regulations in such a way that computers can interpret them. This can then be linked up with the latest generation of computer assisted methods and systems already used by the industry. Methodology renewal is also essential to keep the increasingly complex law-making system manageable.

The government wishes to withdraw from markets that might just as well be left to trade and industry, as underlined in the report of the Dekker Committee 'Privaat wat kan, publiek wat moet' (private whenever possible, public whenever required).

Differing from most of the other industrial sectors, the knowledge process in the building sector is highly dispersed, as has been shown earlier and depicted in figure 2. Most of the parties only take responsibility for their own part in the process; nobody feels any overall responsibility.

The system of regulations and Standards forms an essential link in the knowledge process, so we should continue to invest in it for further development and maintenance. However, that does not happen sufficiently.

In figure 4 we have indicated several points of improvement in the knowledge cycle. The question now arises: should the government leave all this to the market?

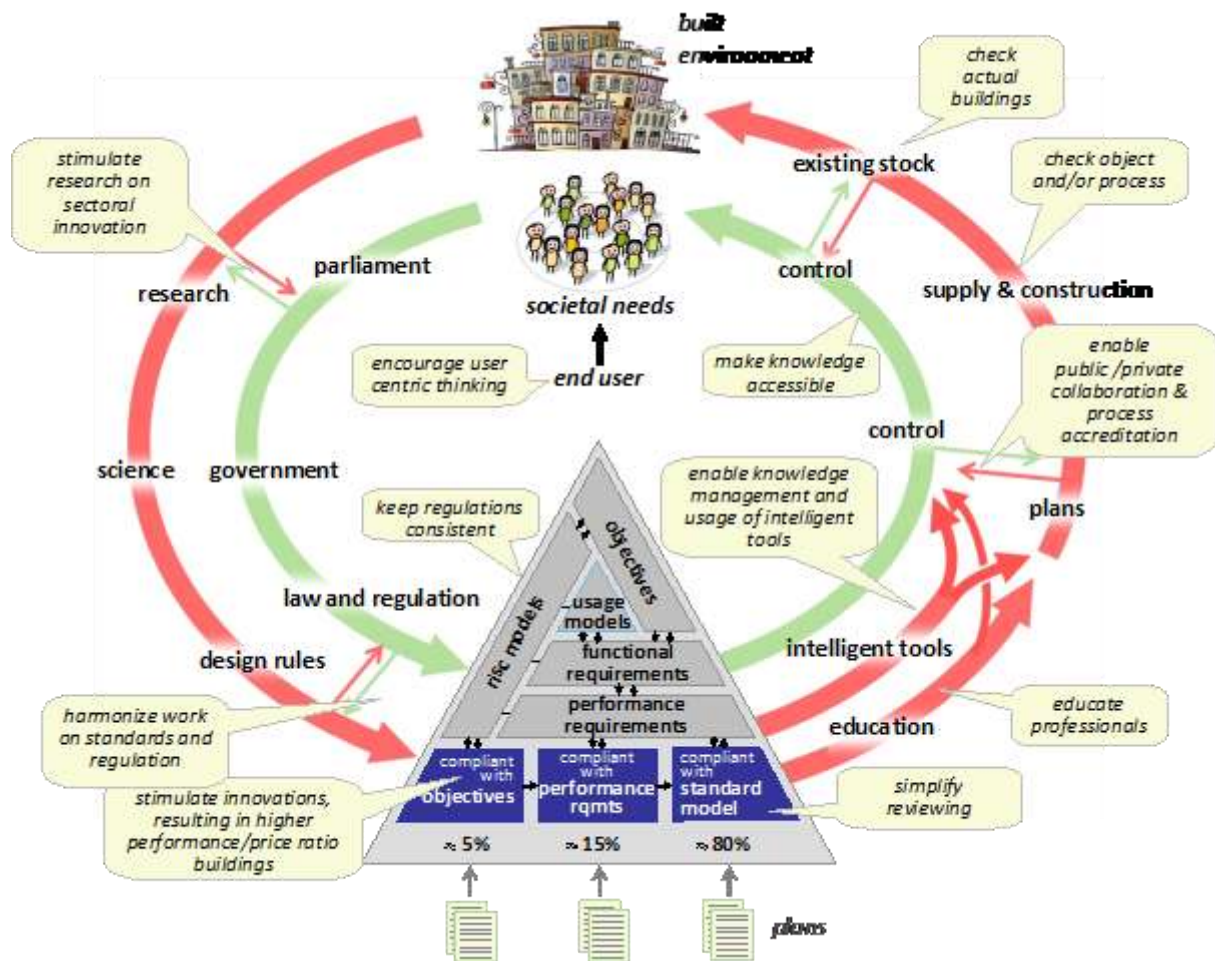


Figure 4. Vision on future development of building regulations in closed and linked public and private law chains of knowledge
(Source: Scholten *et al*, 2010)

Another option is: a combined public/private system.

The present public system of assessment against building regulations is directed at the granting of an Omgevingsvergunning (environmental permit). Moreover, the insurance industry could develop a generally acknowledged private assessment system, covering everything, including conveyance. In this scenario insurers should only be willing to insure risks after a commissioning client has first performed such an assessment. This reduces risks for the insurer and increases guarantees on quality delivered for consumers. For simple construction works, built according to the solutions method, such a guarantee is not required; in which case the client can choose for building with or without a guarantee. The private system proposed is also suitable for matters concerning labour conditions. Should contractors construct buildings with such a guarantee, the authorities could then reduce their administrative charges, or they could even decide to drop the public law assessment altogether. In any case, this solution would require less public law inspection on the spot. In the same way an insured guaranty at the sale of a building can prevent claims of insufficient performance.

In an organisational sense, acknowledgement should be organised for independent technical-legal arbitration, so that for applicants which have a conflict with authorities on technical points, the dispute can quickly be settled on technical-legal arguments. The formal road of objection and appeal according to the Algemene Wet Bestuursrecht (General Administrative Law) is much too cumbersome for this.

Furthermore, the knowledge should become easily accessible and actively promoted through training, publication, the internet and knowledge systems – and transferred to - professionals in - the building chain as well as the law enforcement organisations.

Moreover, emphasis could shift from design to process assessment, and possibly to process certification. That is to cover the complete process from design to the building process, including quality management and guarantee after conveyance. This quality related thinking (ISO 9001) has been accepted in many sections of industry, but what would this mean for the organisationally strongly fragmented building sector? The ultimate test in quality related thinking is customer satisfaction, but as already stated, the actual customer, the end user, generally, takes not part in the Dutch building process. Besides, designers, contractors, suppliers, and authorities have shared responsibilities: nobody feels accountable for the whole process. Although integrated contracts are becoming increasingly popular -owing to the need of integral accountability -they still only constitute a tiny part in the present market.

Furthermore, we now see the development of computer-interpretable provisions and regulations and knowledge based rules as well as methods of numerical analysis; thus everybody can automatically assess a design according to BIM, building information models, before applying for a permit (Gielingh *et al.*, 2010). Naturally, the applicant and law enforcing organisation ultimately remain accountable for the integrated design. Only when builders and applicants do have the overall knowledge, buildings will be realised that not only actually meet the regulations on paper but also in practice.

Moreover, with a coherent approach also methodical improvements can be implemented and monitored leading to consistency that, by means of reference, forms part of the same chain of knowledge.

5 Economic and societal relevance

Structural regulation fulfils a key role in the translation of essential societal needs regarding the built environment. As we are all regular users of that built environment, whether it be living, working, recreating or travelling, that regulation is of essential societal significance.

However, everything has its price. When we look specifically at the development, learning, applying, enforcing and implementation of the rules and regulations – which we have symbolically represented with the two knowledge circles in figures 2 and 4 – then this refers to a process which involves thousands of specialists on a daily basis. There are no exact figures on the commitment of people and costs.

Also, the construction, management and maintenance of real estate involve substantial amounts of money. Some expenses directly contribute to the quality of the built environment; other expenses are needed solely to apply regulations, so at the best they contribute indirectly to the safety, health and sustainability of buildings. The latter expenses are probably partly unnecessary and too high.

Moreover, costs arise when a design or existing works does not meet the regulations set, because the applicant simply knows them insufficiently and/or due to limitations in the enforcement system. At present, enforcement takes place mainly by means of random checks based on paper building plans. Enforcement should take place much more on the basis of buildings actually constructed, specifically with a view to the real risks for which these regulations have been written.

According to some estimates tens of millions of euro could be saved with our proposals for renewal of the system as a whole. When the knowledge circle is ignored there is a risk of needless costs for society. The unnecessary costs to renew the existing building stock in case of Building Decree 2012, developed with the only goals to diminish the volume of regulations to get less administrative burden, are estimated ad € 5 mld and the administrative burden will still be the same. On the other hand a lot of interpretative discussions are expected and technical insufficiencies are not solved. The reason for more than 170 questions of the Parliament to the Government.

How much the improvements we propose will actually yield, cannot be estimated accurately, but with a conservative estimate we set it at 10-20% of the direct costs; with an estimated annual regulatory effort of € 1.2 – 1.6 billion and a building production of about € 60 billion, this would lead to an annual cost reduction of € 120-240 million for local authorities and trade and industry (Scholten *et al.*, 2010). We have here excluded the societal and economic advantages for the

building sector, management and use of real estate, but these advantages will as estimated also be very high, expressed in money: hundreds of millions of Euros per year.

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