Appendix 1.3

Rationale and relevance of the information provided by quality signs

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1 Introduction

Work Package 1 (WP1) of the ELIOS2 project is mainly focussed on a major element of the work programme presented in the call for tender:

> ***Development of an EU directory on quality/conformity marks (labels, certificates, technical assessment, etc.) for construction products, processes, works, technical equipment and professional qualifications***

This development includes:

1. *An inventory of quality/conformity marks in all EU-28 countries used in construction markets for products, processes, works, technical equipment and professional qualifications together with an appraisal of the level of impartiality of the procedures that are used to deliver the quality marks;* (deliverables D 1.1, D 1.6, D1.7)
2. *A critical analysis of the rationale and of the relevance of the information provided by the quality marks to the operators of the construction value chain and to investors, including the compatibility and complementary issues with the CE marking;* (the present deliverable D 1.2)
3. *An appraisal of the conditions and of modalities to be followed by construction operators in order to access to the quality/conformity marks, including those related to the mutual recognition of the marks by Member States;* (deliverable D 1.3)
4. *An assessment of the possible impact of the quality/conformity marks on the competitiveness of construction businesses and the functioning of the Internal Market;* (deliverable D 1.4)
5. *Evidence and assessment of the extent to which the quality/conformity marks are used in practice by the insurance sector, including in the context of cross-border services. The assessment will consider possible constraints on the Internal Market resulting from common practice in insurance.* (deliverable D 1.5)

> *The EU directory on quality/conformity marks covering the above-mentioned aspects (i.e. their scope by product, process, works, etc., their relationship with the EC marking, their modalities, etc.) and accessible on Internet. The main recipients of this directory are professional services providing expertise and advice to construction operators, investors and (re)insurance.*

The proposal of the ELIOS2 project team to use “quality sign” (QS) as a generic expression was agreed on at the early stage of the project. The ELIOS2 directory of quality signs is on line: http://signsdirectory.elios-ec.eu/

The present **draft report** addresses point 2 of the above list: "*a critical analysis of the rationale and of the relevance of the information provided by the QS to the operators of the construction value chain and to investors, including the compatibility and complementary issues with the CE marking*"

A first chapter introduces some theoretical references on quality signs with a focus on third party certification (TPC)

A second chapter presents potential uses of QS in the construction industry according to the specificities of this sector.

A third chapter describes how QS within the scope of the ELIOS2 project (i.e. QS concerning construction products, construction systems, competences (of individual and companies) and work performances) are issued in the construction sector according to the needs they are intended to cover.

Rationale and relevance of QS in construction are addressed in chapter four, before introducing elements concerning the complementarity and compatibility of such QS with CE marking.

This allows introducing considerations on the rationale and relevance of. These reflexions are supported by an electronic survey presented in appendixes and will be completed by interviews.

A following chapter addresses the complementarity and compatibility of some of these QS with CE marking.

A conclusive chapter opens perspective for the European construction industry.

2 Introducing QS

Information on characteristics of goods and services are needed in many personal and professional situations. Such information is available through many channels, e.g. advertisement (through printed, TV, radio or electronic medias), documentations (e.g. oral, printed or electronic description of characteristics of goods or services), books (e.g. handbooks on products characteristics).

Before developing rationale and relevance of QS in construction, this chapter introduces theoretical consideration on the economics of standardisation and third party certification (TPC). An example of these considerations in a sector that is far away from construction (i.e. agrofood) completes this introduction.

2.1 The economics of standardisation

The economics of standardisation is not a new topic. This chapter refers to some source documents of pioneer economists in this domain. Recent 1025/2012 regulation on European standardisation (EU, 2012) that introduces up-to-date definitions of key terms (standard, technical specification, product, service) benefits from these reference works.

David (1990) classifies standards according to the economic problems they solve and distinguishes three types of standards:

1. **Interface or compatibility standards**: "*they assure the user that an intermediate product or component can be successfully incorporated in a larger system comprised of closely specified inputs and outputs. A product that conforms to an interface standard can serve as a subsystem within a larger system built from numerous components and subsystems that are provided by different suppliers, each of whom also conform to the same standard*" (David, 1990, p.4). The aim for producer and customer is to limit switching costs (once an actor has invested in one standard, the cost to switch to another might be expensive) and to benefit from network externalities (the advantages of being part of a large network of users). A product that does not conform to industry standards has limited chance to be distributed. The dominant standard is not always the best from a technological point of view since the network effect tends to dominate.

2. **Minimum quality standards**: "*they provide signals that a given product conforms to the content and level of certain defined characteristics*" (David, p.4). This issue is linked to asymmetries of information between suppliers and buyers. This situation favours opportunistic behaviours and impede the functioning of markets by leading to adverse selection (Akerlof, 1970). Indeed, in markets with quality uncertainty, suppliers have a strong incentive to claim that their product is better than it is effectively. However, buyers are aware of this situation and they will not accept to pay for the premium asked by the suppliers. Consequently, low quality suppliers will tend to drive out of market good quality suppliers. This situation is due to the lack of information about the quality of the products/services which opens the possibility of cheating behaviours of suppliers and lead buyers to refuse to pay a sufficient premium.

   Spence (2001) considered that there was a possible solution to the aforementioned problems. He argued that the person holding the information could be able to signal to the other party the quality of the good he/she is selling. "*It should be noted that the information carried by the signal can be productive itself. This will occur if there is a decision that is made better or with greater efficiency, with better information* (p.431)*."*

   Minimum quality standards reduce transaction costs and search costs (the buyer does need to spend time to evaluate the quality of the product). They provide adequate information and help actors to evaluate the risk that they bear.

3. **Standards of information and measurement**: they describe the characteristics of products and contribute to the creation of an environment of trust. For example, it can concern the grades of petrol (unleaded and super-unleaded).

Standards are one element which contributes to the reduction of asymmetries of information between suppliers and between suppliers and customers. As a summary, Swann (2000) considers that "*the existence and use of standards makes it easier to produce, sell and buy products and services. Standards enable a market. They are part of the infrastructure for innovation-led growth*". To be sure that the actors conform with standards, certification procedures became more widespread.

2.2 Third-party certification

Certification of product/process/companies is important to reduce asymmetry of information and to give consumers a feeling of comfort in what they purchase. It is a way for operators/producers to signal to other parties the quality of the product, process or service they are providing. Certification of products is a very important part of innovation and production in general to ensure that products and services are safe.

Accreditation is another way for the actors to demonstrate their competencies. "*Accreditation refers to a proof of competence given by a credible authority; it applies to an entity or a training or education programme abiding by sufficiently stringent and uniform training standards and suitably designed to reach their goals*" (QualiCert, 2011, p.7).

However, the "value" of the signal attached to certification highly depends on the way the certification scheme is organised. This is why third-party certification by an independent preferred to first or second party certification schemes: "*Third-party certifiers also appeal to technoscientific values such as independence, objectivity, and transparency in an attempt to increase trust and legitimacy among their customers and to limit liability*" (Hatanaka et al., p.355, 2005).

Third party certifiers play the role of an independent authority that guaranties companies are following certain standards.

2.3 Use of third-party certification in the agrifood industry

The aim of this chapter is to demonstrate considerations concerning certification and other means to bring objective and reliable information to construction actors are also valid for other sectors. The agrifood industry sector was chosen due to the availability of pertinent documents and the strong health issues that are associated to the productions of this sector. This is also a domain with many quality signs.

In the past, when most farmer were independent, running small farm and selling all of their goods locally, consumers knew by reputation whether the product they were buying was good and fresh. Most food was produced locally. And there was trust between buyers and sellers. Since this relationship has disappeared, this kind of trust has disappeared in the food industry. It has also transformed the governance in the agrifood industry.

The first certifications on safety and quality of products came from governmental organisations. However, with the development of the global economy international governmental bodies and the private sector have started to play a greater role in standards and certification setting and enforcement. This development has also led to the development of third-party certifiers.

"*It is the independence of third-party certifiers from other actors in agrifood commodity chains, namely buyers and sellers, which distinguishes TPC from first (audited by suppliers) or second-party certification (audited by retailers' paid technicians)*" (Tanaka et al., p.358, 2005).

The delivery of third-party certification is usally a four steps process:

1. The supplier asks to be certified and applies for the process;
2. The third-party certifier reviews the documentation concerning the supplier's facilities and production operations;
3. A field audit is conducted;
4. Conformity against specified requirements is checked and a certification allowing the supplier to certify its products is issued.

In this process, suppliers are responsible for meeting the costs of the audit (for TPC) except for the TPC operated by Fairtrade International (a global organization working to secure a better deal for farmers and workers www.fairtrade.net/) who has established a mechanism whereby consumers bear the cost of the audit in order to maximize returns to small producers in developing countries.

The retailers (giant chains which dominate the market and compete more on quality than prices) who are at the interface between consumers and producers and are seen by consumers as responsible for food safety, were at the origin of the growth for TPC. TPC indeed provides them with several advantages:

- TPC allows differentiation between agrifood products;
- TPC ensures the consistent implementation of standards regardless of the product's origin;
- TPC minimises transaction costs and financial liability (liability and also the cost of monitoring food safety shift from retailers to TPC);
- TPC can be used as a marketing tool.

There are also limitations:

- Small-and-medium sized suppliers may not be able to invest to meet the requirements of TPC (e.g.: the cost of new equipment, the labor cost due to the day-to-day tasks of documentation…). Thus, these suppliers may leave the market of large chains. This issue is particularly strong in developing countries. Local producers frequently ignore the standards required by retailers. Moreover, local producers are not familiar with standards which represent Western values and do not incorporate local conditions and stakeholders (Hatanaka, 2010);

- Certification is perceived as a formal inspection (by an auditor) rather than a valid examination of quality standards (e.g. poultry sector). One solution could be to perform risk oriented auditing (intensification of control where risk is high – Albersmeier et al., 2009);

- Competition between control bodies can jeopardize the functioning of the control system. This situation happens when certifiers minimise their audit costs in order to win the contract. In this case, profit is realised on the long run and is based on stable business relationship between the auditor and the supplier.

3 QS in construction

3.1 Construction process

Each construction project is a new technical, financial and environmental challenge. Many of these projects are unique and some others are exact or nearly duplications of previous projects based on

traditional technical solutions. Experience gained over time by construction actors shows that some tasks are similar, if not identical, from one project to another (especially for “ordinary” buildings, e.g. individual or collective dwellings). The uniqueness of some projects creates strong and often risky challenges.

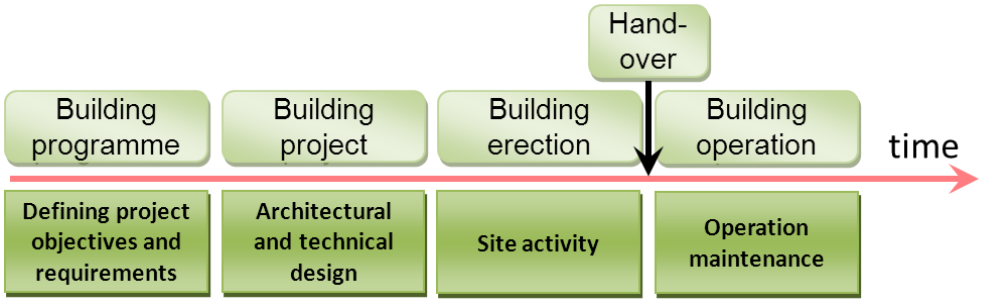
The traditional aspect of construction is closely linked to innovation. According to Ján Figel, former European Commissioner for Education, Training, Culture and Youth *"Architecture is a highly visible showcase of creativity and innovation“* (http://europa.eu/rapid/press-release_IP-09-664_en.htm?locale=en)

Construction is definitely a mix of tradition and innovation. Construction actors contribute to make “*architecture an expression of culture*”[1].

The variety of descriptions of the construction process reflects the diversity of possibilities to organise each project according to its context (e.g. purpose of the building, financing, technical difficulty). Nevertheless, these descriptions all refer to few essential phases presented in Figure 1.

A temporary construction team is organised on purpose to design and realise projected building works. Depending on the context, operation of buildings can be included or not in the scope of the project.

Figure 1 : generic main phases of construction projects



During these phases, information exchange between construction project stakeholders is huge. Information flows concern all aspects of projects: technical, legal, insurance, financial, ... Especially at the beginning of a project, the accuracy and pertinence of this information is essential as most of future project costs are consequences of early decisions made during the process (Figure 2).

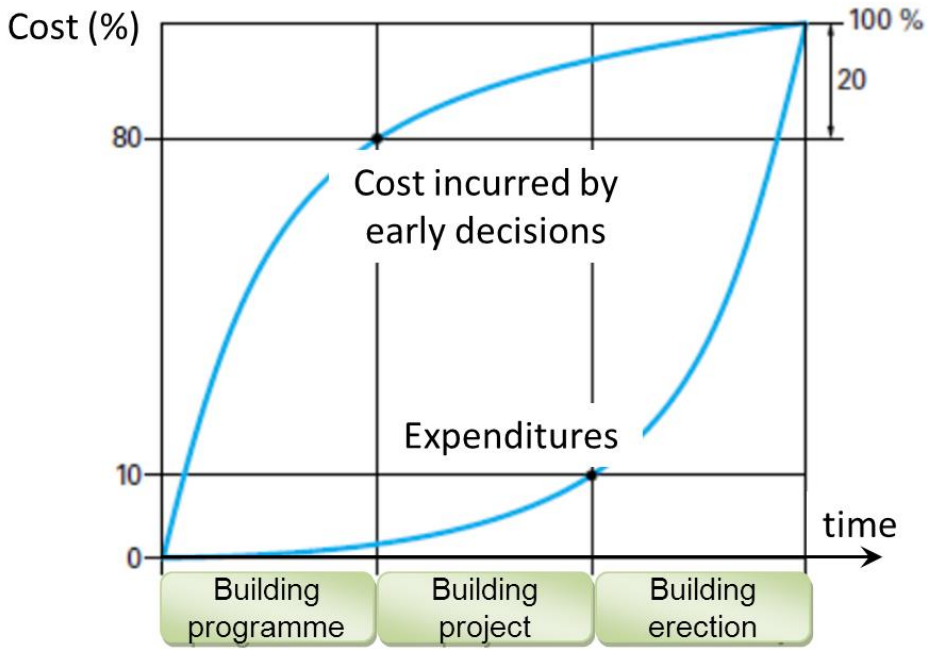
Moreover, accurate, up-to-date, shared information is also critically important to prevent future defects during the building life. Non-quality costs are mainly rooted in these early phases, e.g.:

- inappropriate programme,
- insufficient ground inspection may lead to inappropriate foundation design,

[1] Article 1 of the 1977 French law on architecture states: „L'architecture est une expression de la culture“ http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000522423

- insufficient analysis of the consequences of modifications concerning one particular expected performance (e.g. energy performance) on other performances (e.g. acoustics) may lead to inappropriate performances during the hand-over procedure and trigger insurance claims ,
- lack of precise specifications concerning equipment may imply late modifications of structural elements that may be sources of consequential defects (and costs) that may emerge years or even decades after hand-over.

Figure 2 : impact of early decisions on the project cost (adapted from GOBIN, 2006)
NB: the figure considers a case where operation is not in the scope of the project



Other reasons may hamper the exchange of information between construction projects partners:

- the temporary project organisation of any construction project,
- occasional interventions of contractors and sub-contractors who have a limited access to information concerning the project,
- loose coordination of operators belonging to different companies.

Tools have been developed to improve these situations: quality management (ISO 2014), concurrent engineering (Gobin 2006), performance-based approach (MERLET 2013), Building Information Modelling[2] (BIM) (BuildingSmart 2014). Their effective use depends on projects characteristics (e.g. demands of the client, budget, complexity).

[2] The Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC was voted by the European Parliament on 15 January 2014 and adopted by the Council on 11 February 2014. This European Union Public Procurement Directive (EUPPD) will enhance all 28 EU member states to encourage, specify or mandate the use of BIM for publicly funded construction and building projects in the EU by 2016. http://ec.europa.eu/internal_market/publicprocurement/modernising_rules/reform_proposals/index_en.htm

3.2 Building works: a man-made system

Risks associated to each specific construction project depend on many of the above-mentioned technical and human factors. When insurance is available, insurers use many sources of information to assess the risk level according to the insurance contract, e.g. context of the project, technical choices, financial and technical profiles of companies.

In spite of all precautions, costs of non-quality are relentlessly recorded (as long as such records are made, i.e. in most cases, through insurance claims). In addition to pathology cases, time lost on site, delays to deliver works, defects not covered by insurance, poor satisfaction of clients, loss of reputation of some companies are other forms of non-quality.

Academic studies try to address economic evaluation of non-quality issues. Depending on the scope of these studies, evaluations range from a few percentage points to more than 15% of project costs (ABBASNEJAD 2013). In any case, stakes associated to non-quality costs are high as regard to the level of margin of the construction business (GOBIN 2006).

Routes to follow for improving this well-established situation have been known for long but improvements are still to come.

Even ordinary buildings are complex man-made systems. Their behaviour is first of all governed by the law of physics. But the actual behaviour of building systems is also strongly influenced by the behaviour of occupants (e.g. occupancy conditions, maintenance), by political decisions (e.g. energy regulation), by the general economy (e.g. price of energy).
A major cause of building pathology is due to disequilibrium of the building system. This may be due to loose design and/or implementation, as well as to misuse of the building by occupants including the absence of maintenance.

Excessive humidity is a typical illustration of such a situation (Figure 3). It may be due to:

- wrong design (insufficient air flow rate through the building),
- loose implementation (narrowing or obstruction of air ducts during site phase),
- excessive production of humidity (compared to design specifications),
- absence of maintenance (fouling of air ducts due to the absence of cleaning),
- misuse by occupants (voluntary obstruction of air inlets/outlets).

Construction products and systems (see definitions below) must be chosen according to expected performances of building works. The relation between adequate choice of products/systems and performance of work is not straightforward at all. Many combinations of available construction products and systems can potentially meet targeted works performance goals.

Construction products and construction systems are defined as:

- **Construction products** (e.g. bricks, roof tiles, cement, tubes) defined as *"any product or kit which is produced and placed on the market for incorporation in a permanent manner in construction works or parts thereof and the performance of which has an effect on the performance of the construction works with respect to the basic requirements for construction works"* (article 2 of the CPR)

- **Construction systems** (e.g. external thermal insulation systems, ground heat pump systems, building integrated photovoltaic systems) defined as a set of products, accessories and specific design, implementation and maintenance rules to fulfil and maintain functions awaited from buildings or building parts. Interfaces of systems with other building systems/parts are a key issue as they have to ensure the continuity of crucial functions (e.g. water tightness, acoustic isolation, thermal insulation).

Figure 3 : Illustration of excessive humidity and of some causes (Source CSTB - DDASS 67))

Mould development

Excessive humidity production

Dirty air outlet

Clean air outlet

A wide range of possible choices among competing construction products and systems is proposed on the market. Price, adequate technical characteristics, compatibility with local technical skills, timely availability belong to the list of selection criteria. The selection of “ideal” construction products or systems would nevertheless not guarantee building works would perform as expected.

Actual performances of works are indeed the outcome of the construction process described previously. During major phases of this process, many events may occur that may limit chances to meet expected performances. Building pathology observation and records over decades illustrate this statement.

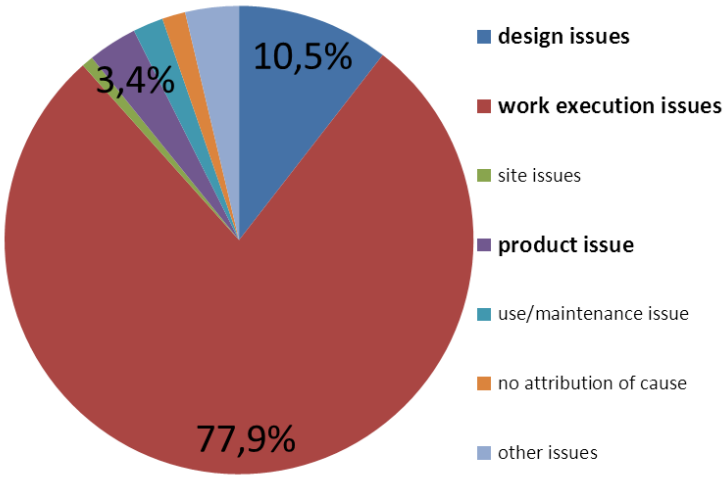
Main causes of pathology identified on Figure 4 show that construction products and systems as such are rarely the main cause of pathology. Work execution and design issues are far more frequently the main reasons for building works pathologies. WP2 deliverables of the ELIOS2 project provide further examples for eco-technologies.

Repair costs induced by these pathology issues rank differently than their frequency (Table 1). Though design issues are less frequent than work execution issues, the former cost much more than the latter.

Table 1: repair cost of pathology issues in percentage of construction costs in France, period 1995-2012 (adapted from AQC 2013)

Pathology source	% of construction cost
Design issues	9.5 %
Work execution issues	3.4 %
Site issues	3.8 %
Product issue	5.3 %
Use/maintenance issue	2.4 %
No attribution of cause	3.4 %
Other issues	3.0 %

Figure 4 : Origin of building pathology in France period 1995-2012 (adapted from AQC 2013)



These French references must not lead to the conclusion the situation is limited to France. In this country, the Agence Qualité Construction (AQC) provides statistics on pathology cases. Eighty per cent of these cases come from insurance claims resulting in application of the French insurance scheme (http://www.qualiteconstruction.com/observation/sycodes.html) .

Even if not unique, the existence of such statistics is not widespread in EU-28 countries. Diffuse sources confirm the existence of pathologies and associated costs (refer to WP2 deliverables).
Observations confirm great attention must be paid to essential aspects during the construction process in order to achieve performance goals:

- careful planning and realisation,
- need for complete set of design data, reflecting a thorough analysis of interrelations between intricate demands of performances (e.g. energy, acoustics, mechanics, health),

- the continuity of performances through interfaces between building parts does not only result from products characteristics but also from a detailed analysis of these interfaces and from a close monitoring of the execution on site (e.g. thermal or acoustics insulation, vapour barrier),
- data on characteristics of construction products are not sufficient as such: they need to be considered together with the context of the project (e.g. budget, interaction between the different expected performances of future works, use of buildings, technical capacities of designers and contractors),
- data concerning construction systems generally include a description of the design and implementation conditions (in order expected performances of systems are met when systems are integrated in works).

3.3 Information: a core issue

These considerations suggest information concerning construction products (P), construction systems (S), competences of construction professionals (C) are of the utmost importance in order performances (W) of built works can be displayed (and possibly "guaranteed") to clients. Figure 5 intends to show where such information is used during the construction process. The information content of a quality sign is important for construction actors rather than the existence of such a sign (e.g. demonstrated by the display of a logo). Information on these four subjects has to be considered as contributions to possible solutions to issues observed during any construction project (Figure 6).

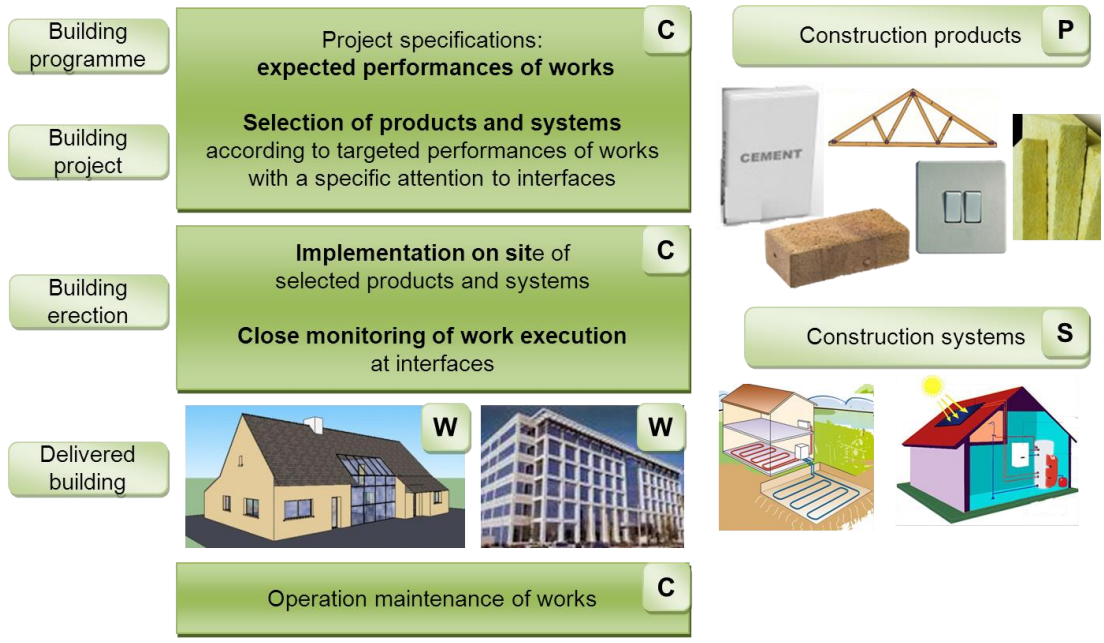
Most of these issues are located at interfaces between phases where information is transferred from one actor to another. Consequences of incomplete, erroneous information can flow downstream the construction process and be at the origin of further defects of construction works. Fundamental elements presented above highlight the importance of information flow between construction stakeholders for each project. Described situations refer to observed projects (both new buildings and refurbishment of existing buildings) and are also relevant for recent projects displaying high (energy) performances.

Aiming for higher performance goals does not call for revolution in construction but for more attention to details of organisation, right skills, adequate information availability and exchange, control at pertinent moment of the construction process. Recent analyses of such projects confirm these statements (IFB42 2012, RAGE 2012).

The outcomes of these analyses reinforce strong needs for:

- thorough design anticipating implementation and operation/maintenance,
- effective and efficient coordination/control and involvement of the construction parties during the design phase and on site,
- information of the occupants on "how to use" (energy) efficient buildings,
- training of professionals to fully integrate the importance to carefully follow design instructions with a specific attention to interfaces between building works.

Figure 5 : Where/when information on Products, Systems, Competences and Works are needed during the construction process



The development of commissioning will probably participate in performance improvement as it is a way to check the effective performance level and to make corrections if necessary (LEED 2014). As for previously mentioned tools of progress (i.e. quality management (ISO 2014), concurrent engineering, performance-based approach, BIM) such commissioning tools must be adapted to projects characteristics (e.g. demands of the client, budget, complexity). It could be counterproductive to use such tools for "ordinary" buildings. Adaptation is needed.

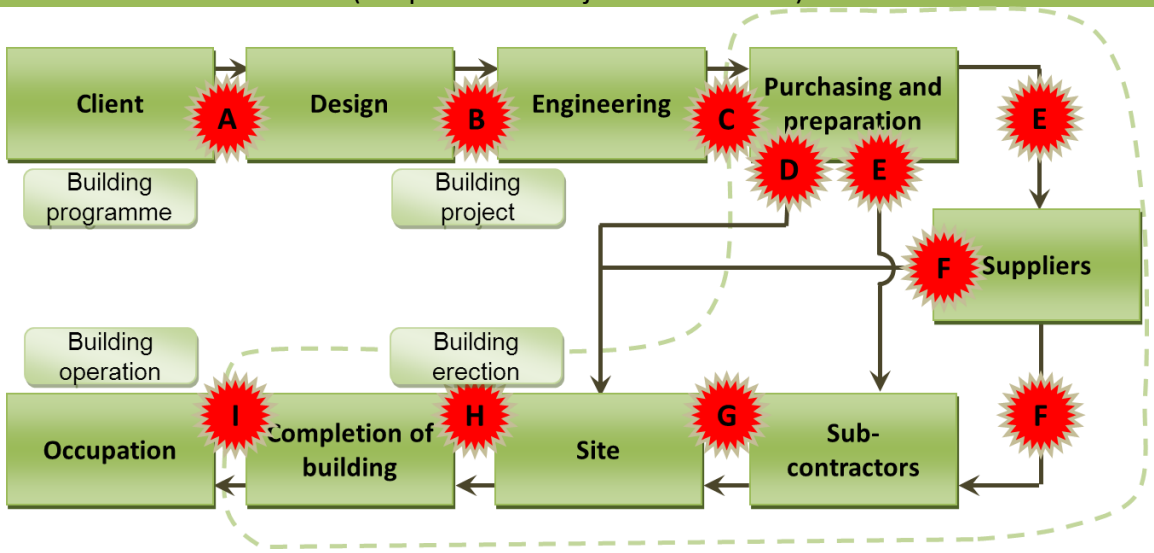
3.4 Information on dos and don'ts

Construction stakeholders have for long tried to improve the above described situations. Experience gained from a multitude of projects and observations of pathology provide a huge amount of knowledge.

This information is processed to provide generic information to construction actors. Does and don'ts concerning both traditional and innovative works are for instance accessible in different countries as shown in the following non-exhaustive list:

- Denmark: BYG-ERFA https://byg-erfa.dk/erfaringsblade
- France: SMABTP http://www.smabtp.fr/SGM/jcms/gsr_15534/fr/fiches-pathologie-et-illustration
- Netherlands:
  - Bouwtransparant http://www.bouwtransparant.nl/.
  - SBRCURnet http://www.sbrcurnet.nl/
- UK: http://www.nhbc.co.uk/Builders/ProductsandServices/

Figure 6 : Location of some issues along the construction process (adapted from Vrijhoef et al. 2001)



A	- Difficulties finding out client's wishes - Changes of clients wishes - Long procedures to discuss changes	**E**	- Inaccurate data - Information needs are not met - Adversarial bargaining - Order changes
B	- Incorrect documents - Design changes - Extended wait for architect's approval of design changes	**F**	- Deliveries not according to planning - Wrong and defective deliveries - Long storage period - Awkward packing
C	- Inaccurate data - Engineering drawings not fit for use	**G**	Subcontracted work not delivered according to main design, contract and planning
D	- Inaccurate data - Information needs are not met - Unrealistic planning	**H**	Problematic completion due to quality problems
		I	- Unresolved quality problems - Delayed occupation due to late completion

These pedagogical documents are based on concrete pathology situations. They explain why they happened and how to avoid them through adequate design and actions on site. Doing so, they address the importance of having the right information at the right time according to each particular project.

Some of this information is conveyed by QS, defined by the ELIOS2 project (ELIOS2 D1.1 2013) as:

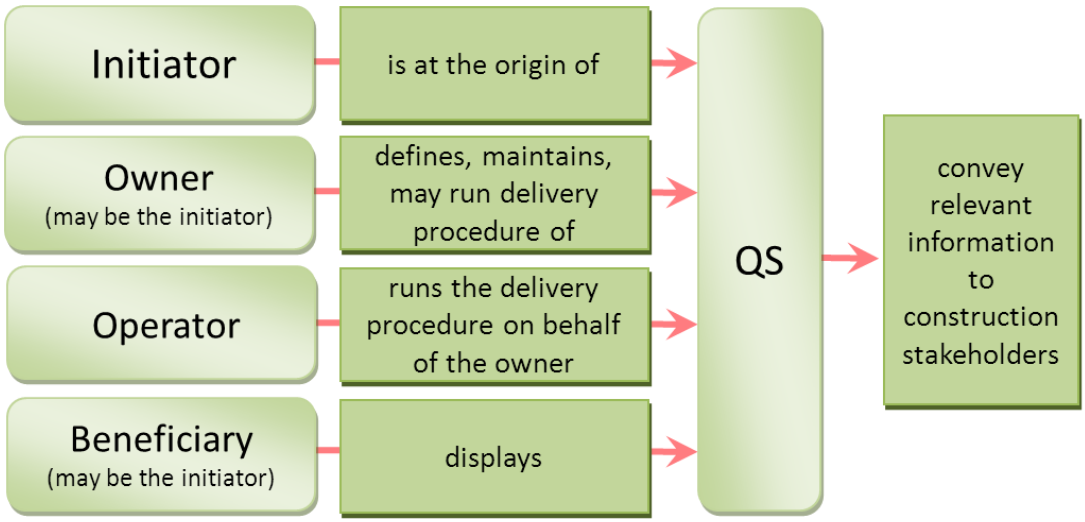
"any kind of sign on the basis of which (construction) stakeholders rely on or give credit to when decisions or choices have to be made."

QS is one of the information supports used in construction to transmit relevant information to construction partners all along the construction process for each and any construction project. Elaboration, rationale and relevance of QS are presented in the following chapters.

4 Elaboration of QS

Producers/suppliers of goods and services concerned by QS may be considered as the beneficiary of the procedure (Figure 7).

Figure 7 : upstream and downstream of QS delivery procedure



The ELIOS2 project does not pretend to cover all types of information on any subject. It focuses on information concerning four subjects, according to the demand of the European Commission (EC 2011):

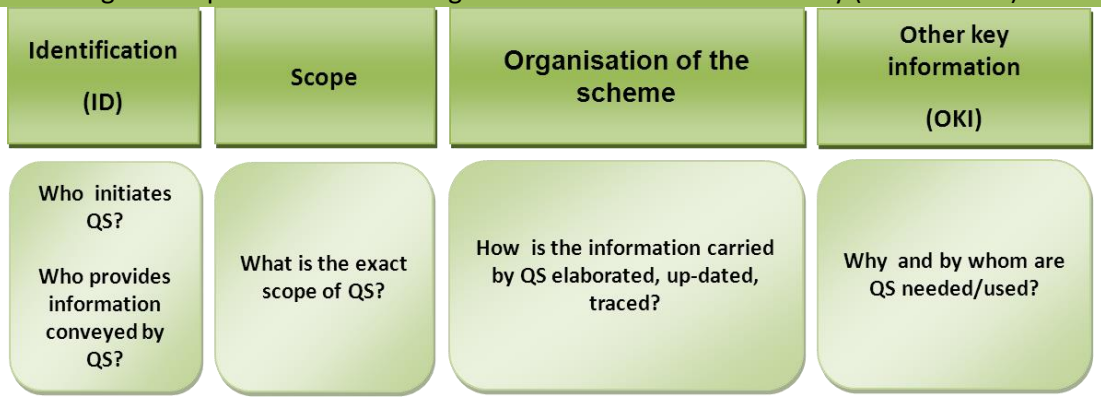
- construction products,
- construction systems,
- competences (of individuals and companies),
- work performances.

Accessing to relevant information costs time and money. The best interest of construction professionals is to strike a balance between relevance and cost of QS. This balance takes answers to the following questions into account:

- why and by whom are QS needed/used?
- who initiates QS?
- what is the exact scope of QS?
- who provides information carried by QS?
- how is the information carried by QS elaborated, up-dated, traced?

These issues are further discussed in the present chapter. They reflect the structure of the directory of quality signs (http://signsdirectory.elios-ec.eu/) developed during the ELIOS2 project (Figure 8).

Figure 8 : questions match the general structure of the directory (ELIOS2 2013)

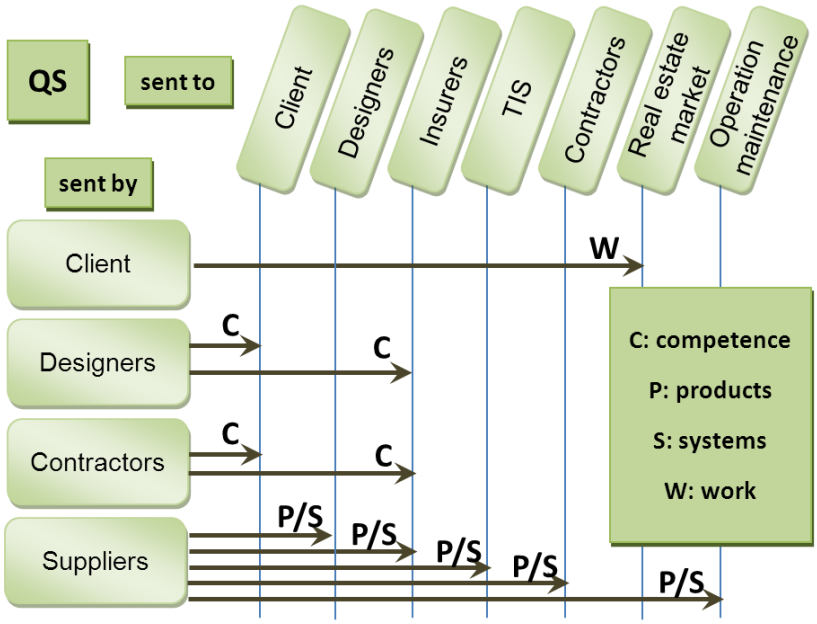


4.1 Why and by whom are QS needed?

Figure 9 is an attempt to represent main information channels followed by information conveyed by QS considered by the ELIOS2 project. The arrows indicate the flow of information from the beneficiary of QS to their communication targets. For instance a client (e.g. a property developer) will be keen to display QS concerning performances of buildings to potential investors/tenants. Manufacturers/suppliers will inform their direct and indirect clients of the characteristics of construction products and systems they produce/deliver.

Many other situations could be illustrated (e.g. some contractors/suppliers can send W-QS to the market when they provide complete houses or simple office buildings) but we chose not to be exhaustive for the sake of clarity of the figure.

Figure 9 : illustration of some main information channels for QS on P, S, C and W



Technical Inspection Service (TIS) is a key function during construction project. It is for instance performed by building controllers who use QS concerning construction products and systems as well as competences. The precise definition of his role depends on national context is analysed in WP3 deliverable reports.

The mission of TIS can for instance include:

- Assessment the compliance of the planned construction project vis-à-vis local regulatory aspects (e.g. structural, energy, acoustics) at the stage of the building permit,
- Assessment of risks from design documents,
- Control of the execution of contractors during the site phase
- Supervision the control of quality management plans of contractors
- Check of compliance to regulatory aspects before hand over.

To ensure his mission, TIS also uses a lot more other information exchanged between participants to a construction project (e.g. plans, design notes) (Figure 10).

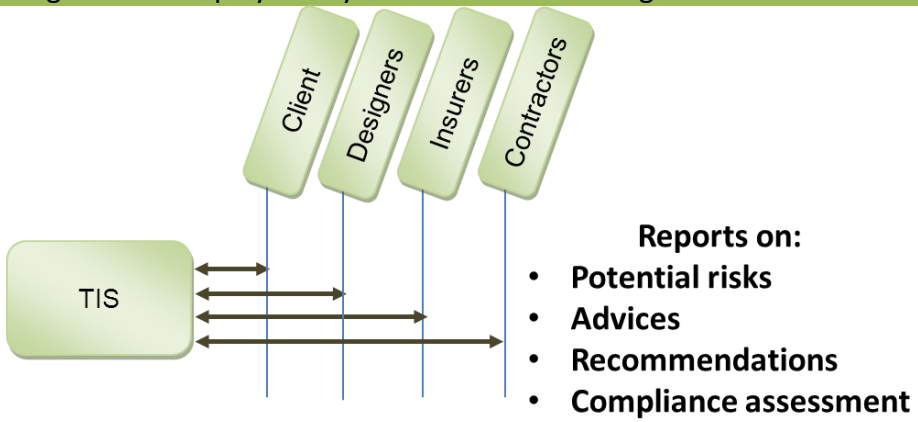
During his mission, TIS can also play a key role vis-à-vis insurers. TIS can indeed provide crucial information to the insurer to assess specific project-related potential risks (e.g. pathologies, difficulties due to the availability of technical and human resources).

These assessments require access to discriminant information on any risky aspect of a project. Some QS can convey such discriminant information.

For instance, the demand of the client for a high energy performance building through the incorporation of an innovative cooling system (e.g. chilled beam) will be carefully assessed by the insurer. He will thoroughly analyse consequences in terms of (un)fitness for purpose of the building (i.e. issues that prevent the property from being used as expected) in the perceptive of issues linked to the operation of the system.

As a consequence, QS concerning products are less important for insurance than technical assessment of innovative systems in the particular context of a project.

Figure 10 : TIS plays a key role defined according to the local context



4.2 Who initiates QS?

Initiators of QS (Figure 7) directly refer to the rationale behind the decision to create/publish QS: provide relevant information needed by construction players.

Different profiles of QS initiators can be distinguished:

- **PUBLIC AUTHORITIES** (European, national, regional, local) may initiate QS in accordance with e.g. safety, environmental policies they are in charge of. They will for instance make mandatory the display of QS covering relevant characteristics of products/equipment. They may also require these products are installed by competent persons/companies. In this latter case, specific QS (e.g. qualification) will attest a person/company is competent for such an installation.
  Public authorities generally own the concerned QS (e.g. CE marking is owned by the European Commission). They also generally delegate the management of the procedure to operator(s).

- **PRIVATE PLAYERS ON EMERGING MARKETS** (e.g. manufacturers, producers, designers, contractors) may be at the origin of QS. Emerging markets (e.g. green-roofing, PV panels) attract a lot of skilled and unskilled players. Some (skilled) players may decide to set rules of good practice in order to be distinct from other (less skilled) players. QS is a way to show distinctive features (of products, systems, competences) to the market. Beneficiaries of QS (e.g. manufacturers, engineering offices) obviously have a commercial interest in QS whereas "users" of QS (e.g. clients, designers, contractors) ensure manufacturers' interest into obtaining QS that provide them with the objective information they need.

- **PRIVATE PLAYERS ON MATURE MARKETS** may wish to develop/maintain QS to attest that some characteristics of their products or services are in compliance with or 'connect' to national Building Regulations in a particular country (as long as it is outside the scope of CE Marking) (Recital 33[3] of (EU 2011)).

- **QS PROVIDERS** are duly mandated organisms to process QS delivery procedures on behalf of above mentioned initiators. They may also be at the origin of QS for specific goods or services. They have technical and commercial capacity to work together with private stakeholders to develop QS in above mentioned situations on both emerging and mature markets. They may propose market players to help them developing a framework to make adequate QS available. Most of QS providers are independent from market players and are then in a position to provide objective information to professional stakeholders.

[3] *The CE marking should be the only marking of conformity of the construction product with the declared performance and compliance with applicable requirements relating to Union harmonisation legislation. However, other markings may be used, provided that they help to improve the protection of users of construction products and are not covered by existing Union harmonisation legislation.*

4.3 Who provides information conveyed by QS?

Chapter 2 highlighted factors influencing trust in information conveyed by QS. These theoretical considerations allow defining three categories of QS concerning the four subjects addressed by the ELIOS2 project (products, systems, competences, works):

1. a simple declaration by the beneficiary of QS (**first party**) stating that goods or services he provides can demonstrate some characteristics may be difficult to trust as it is based on the beneficiary says only.

2. a declaration made by a **second party** (e.g. clients of the beneficiary) who "testifies" these characteristics are met. Such QS is likely to be more trustable than a first party QS. Information coming from different sources (e.g. clients of the beneficiary)can be compared and cross-checked,

3. QS can also be the result of a procedure carried out by an independent **third party** (independent of the beneficiary and of any of its clients or represented interests). This is typically the case for third party certificates. This procedure can itself be defined in reference documents. The conformity of the QS delivery procedure to these reference documents can also be certified by another third party (accreditation).

4.4 What is the exact scope of QS?

A building work is the outcome of a complex process where construction products/systems are incorporated on site by contractors according to design specifications. Design specifications reflect client's expectations taking into account the necessary compromises between performance levels (e.g. thermal comfort, acoustics, solidity) of construction parts and costs.

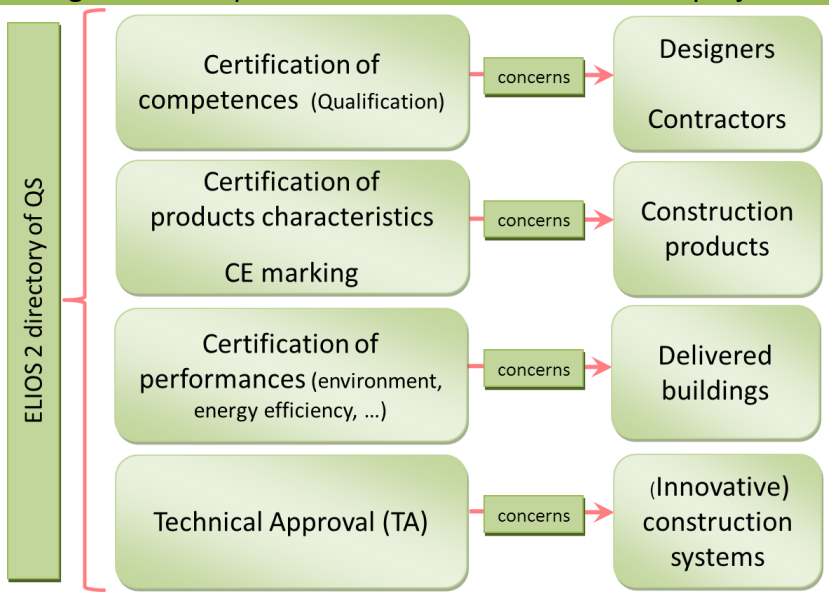
Information QS are likely to concern then highly depends on each construction project. In practice, budget and regulatory constraints (e.g. fire, energy, acoustics) limit design options so that the set of information is de facto restricted. Essential characteristics of construction products cover an important part of information need but specific information (e.g. design rules, implementation/execution rules) is also needed to ensure expected performances of works are met. For instance, the open time of a mortar is essential information for a satisfactory implementation of tiles on a floor.

Most QS do aim to meet specific needs that are to a large extend determined by the local climatic and geological circumstances, work regulations, traditions, uses and competences of construction actors, clients' and users' expectations, installation, execution or incorporation conditions, maintenance and repair.

As a consequence, QS should focus on information that are relevant for local contexts. For instance, displayed characteristics of a product at the end of its production process, as it is placed on the market by the manufacturer, may be misleading in relation to useful characteristics of products in use when the product will reach e.g. humidity equilibrium in local conditions.

Moreover when design options include innovative products/systems, codified design and implementation rules as well as standard characteristics of products are not available. QS concerning innovations (e.g. technical approval category of the ELIOS2 directory of quality signs) bring all relevant information for construction professionals to design, realise (and maintain) construction parts. Figure 11 presents typical scopes of QS according to each of the four subjects.

Figure 11 : scopes of QS considered in the ELIOS2 project

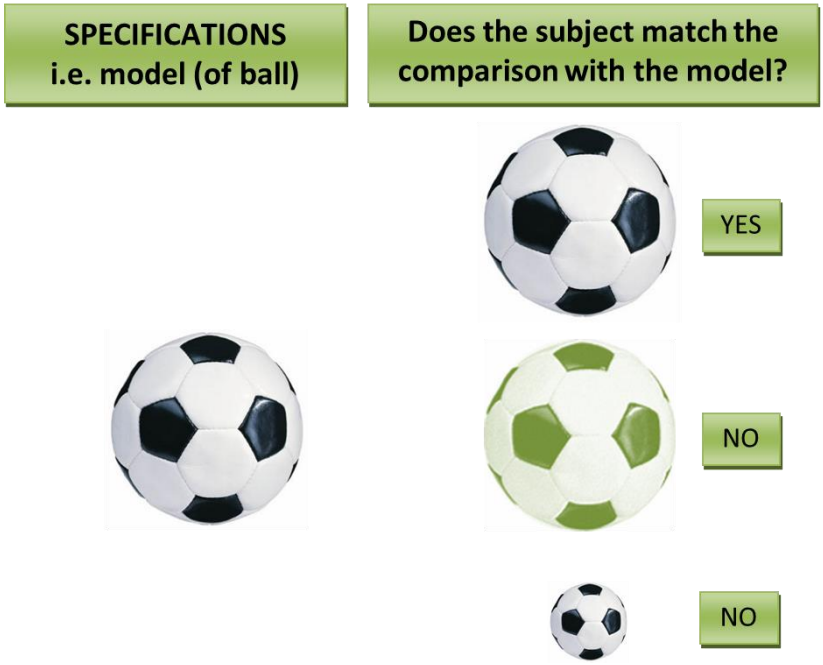


4.5 How is the information conveyed by QS elaborated, up-dated and traced?

Appendix 1.1 of the ELIOS2 final report introduced two main QS types: certification and technical approval (TA). Certification is a generic process that can be applied for different subjects, i.e. construction products, competences and performances of works. TA is appropriate for innovative construction systems.

Certification relies on conformity assessment (Figure 12) to some reference information (e.g. characteristics of products, knowledge of actors), whilst TA as defined by the European Union of Agrément (UEAtc) refers to a package including construction products characteristics, design and execution rules (with possible reference to necessary competences) in order to design, realise and maintain building parts: *"The Approval, regardless of the members that issue it, is the result of a favourable technical assessment of the fitness for purpose of materials, products, equipment or processes, such assessment being made taking into consideration safety, health, the use and sustainability of the works and any other matter related to works in which they are to be used. The Approval states the scope of application, conditions and possibly limitations."*

Figure 12 : Comparison/conformity principle



In each case, the procedure that compares actual characteristics of the subject to reference characteristics is described in specified requirements. These documents precisely define up-dating rules and associated quality management procedures.

Rules are defined by the concerned stakeholders and therefore do address their needs and requirements for the quality of the construction work. Experience and feedback from construction sites are taken into account to update rules.

Assessment procedure is defined considering potential risks or consequence of a product defect. Risk assessment takes the role of products in the work or for a service into consideration, as well as necessary competences to incorporate these products in construction works. Technical assessment means, conception diagnosis, testing, audit, and their frequency may vary depending on risks that are identified.

TA focuses on the assessment of construction systems defined as a set of products, accessories and specific design, implementation and maintenance rules to fulfil and maintain functions awaited from buildings or building parts. Interfaces of systems with other building systems/parts are a key issue as they have to ensure the continuity of crucial functions (e.g. water tightness, acoustic isolation, thermal insulation).

5 Rationale and relevance of QS in construction

Rationale expresses the reasons why QS are made available to construction actors.
Relevance refers to the adequacy of the information content of QS.

5.1 Rationale

Whatever the origin of QS, initiators may have motivations among one or more of the following:

SENDING A DISTINCTIVE SIGNAL TO THE MARKET:
Construction products manufacturers, construction systems providers, companies (e.g. designers, contractors and developers) are operating on a competitive market. Advertisement is a channel to send a distinctive signal but in most cases advertisements are insufficiently reliable, credible and traceable to convince actors in the construction sector where financial and technical stakes are high (e.g. one of the most important investment home owners make during their lifetime). Advertisement is indeed an example of first party QS unless it refers to more reliable information such as third party QS, e.g. certification of competences, of works performances, of characteristics of construction products (not covered by CE marking).

BRINGING CONFIDENCE AMONG INVOLVED PARTIES:
Confidence is a key issue in any economic activity and in particular in the construction business. QS is a simple mean to contribute to creating confidence between involved parties:

- QS on competences bring confidence that actors in the construction chain know how to carry out their tasks,
- QS on products bring confidence
  - that delivered products meet design specifications
- QS on systems bring confidence
  - that expected performances of building works will be achieved (if properly implemented/incorporated and maintained in the construction work)
  - that delivered products being part of the system meet design specifications
- QS on building works bring confidence to the real estate market that expected performances have been assessed and checked.

QS is of course not a panacea. The mere display of QS is not sufficient to create strong confidence but it is a contribution to do so. This is why it is important to access contextual elements concerning the way QS are delivered to better appreciate the added value of QS. Such elements are collected in the ELIOS2 directory of QS.

The fact that third parties convey a statement on competences or fitness for use provides for increased reliability of choices of construction actors during the construction project period. This is a way to promote innovation in construction by ensuring effective user/consumer protection through the use of strong QS. Poor knowledge about innovations and doubt over their performances and durability would lead to construction actors preferring known, reputable and traditional products, systems and services.

LIMITING COSTS and SIMPLIFYING ADMINISTRATIVE TASKS:
Given that concerned parties know and understand the meaning of QS, their use facilitates communication between them. Introducing ex-ante information in the construction process limits ex-post control. Whereas it would take each individual party a lot of time to obtain and examine detailed information on product characteristics and cross checking those with criteria imposed due to regulations and/or works' specific criteria, QS may provide this information by their mere affixing on products. By limiting repeated controls, QS contribute to a cost optimisation approach.

PROVIDING ASSISTANCE FOR APPROPRIATE INSTALLATION/APPLICATION:
As stated in 3.2, the selection of "ideal" construction products or systems cannot guarantee building works will perform as expected. Producers/suppliers may wish to send a signal to their clients to indicate expected performances of works incorporating their products/systems need specific installation/application rules and procedure. TA (e.g. Avis Technique (France), BBA-Agrément (UK), ATG (Belgium), KOMO Attest (Netherlands), Zülassung (Germany) and DIT (Spain)) for instance define such rules and clarify conditions in order to use concerned systems in the best conditons. In addition, certification of competences may be recommended/demanded. Contractual guarantee or insurance coverage can be bound to the effective use of certified applicant.

LIMITING COUNTER-PERFORMANCES
When introducing innovative construction products or systems, the best interest of producers/providers is to create favourable conditions for expected performances of works incorporating their products/systems are met. Such information is conveyed by TA as technical approvals generally include design, execution, installation or incorporation and maintenance and repair guidance. This is necessary because technical approvals cover, almost by definition, subjects that are not standardized, thus for which no codes of practice do exist.

LEVEL PLAYING FIELD
Given that all products, systems or services covered by QS at least meet the same threshold performances, QS lead to pressure for a more level playing field in the region where the QS is used, recognized and understood.

As a consequence, QS are key factors for the construction overall quality. Products with certified characteristics, installed by a certified contractor following a certified design is thought the best way to prevent damage, limit insurance cost and increase the durability of a construction; they are positively impacting the cost and productivity of the construction sector.

5.2 Relevance

When dealing with the relevance of QS, its origin has to be taken into account:

- mandatory QS, introduced by law or regulation,
- non-mandatory (i.e. voluntary) QS, introduced by private or public construction players.

5.2.1 Mandatory QS

Relevance of mandatory QS results from the motivations of legislators who introduce laws and regulations. Such QS are not discriminant as they are mandatory: all concerned products have to display these QS in application of the law.

5.2.1.1 Health and safety issues

Mandatory QS concerning the prevention of accidents as well as the protection of users (considered as a global issue, i.e. including environmental and health issues) are strongly relevant. For instance, safety of e.g. electric or gas installations in buildings is one of the origins of mandatory QS on products and competences. In Germany, regulations provide for lists of products which must meet DIN product standards, those that require a technical approval (Zülassung) and those which do not require specific approvals. In Austria, a similar system exists.

However, in the majority of cases, regulatory requirements do not relate to construction products as such. Many works' requirements impose products to meet certain criteria, depending on specific intended uses.

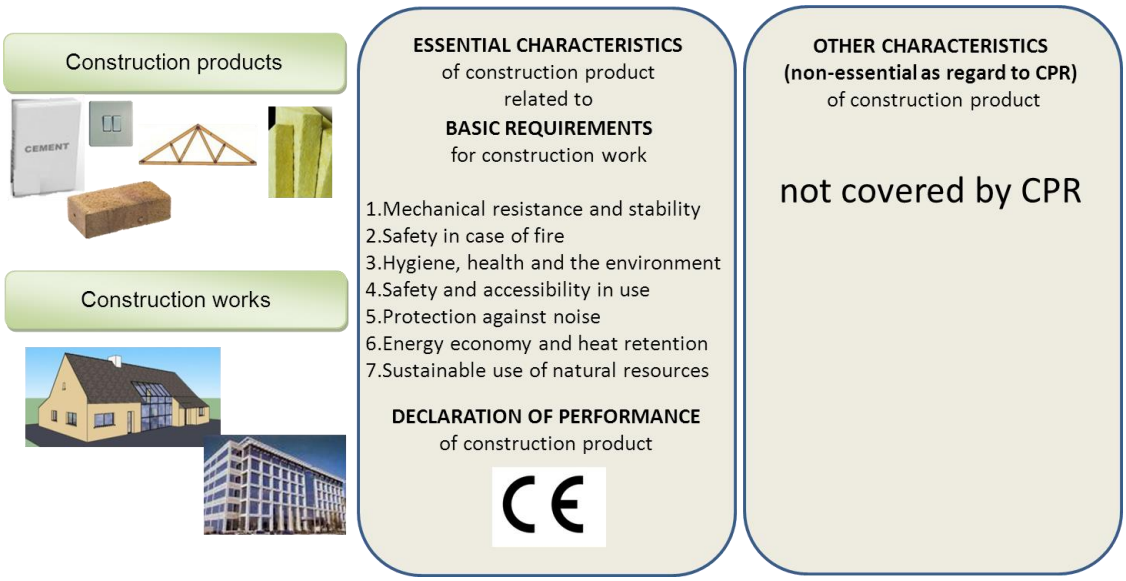
5.2.1.2 CE marking

As regard to the broad definition of QS proposed by ELIOS2, CE marking is considered as QS within the scope of the project. CE marking indeed provides information to construction actors on some characteristics of construction products, as documented in the CPR (EU 2011). Additional information can be found on the FAQ section of the DG Enterprise and Industry web site http://ec.europa.eu/enterprise/sectors/construction/faq/index_en.htm.

The relevance of CE marking lies in its objective: "*to remove technical barriers to trade in the field of construction products in order to enhance their free movement in the internal market*." (Recital 6 of the CPR).

CE marking displays essential characteristics of construction products (Figure 13). Other characteristics of products that are not covered by CE marking may be relevant for construction actors depending on the view they have on construction projects and construction quality.

Figure 13 : Information on products conveyed by CPR/CE marking



5.2.2 Non-mandatory QS

Just like for any other goods or services on a competitive market, the value of QS for professionals involved in construction projects results from their effective use. Non-mandatory QS that would not be used by any such professionals would rapidly be out of the market. On the contrary, the commercial success of such QS is an indication of their relevance for construction actors.

As stated previously, each actor has specific needs and non-mandatory QS try to answer specific questions. This activity is constrained by the limit of transaction costs that have to remain acceptable for all parties.

Insurers do for instance look for information that contributes to risk assessment. QS concerning construction products will not be of the utmost importance for insurers if the information conveyed by these particular QS is not discriminant. Indeed, construction products as such are not a main source of building defects (refer to 3.2).

On the contrary, insurers will look carefully to and analyse QS such as:

- qualifications of designers, engineering companies, contractors as regard to specificities of a particular construction project,
- TA concerning systems or building parts that bring information to assess potential risks attached to a particular project
- certifications of construction systems participating in the health and safety (e.g. structural, fire) of the occupants of buildings (e.g. anchoring systems, fire protection products/systems).

As far as insurers are concerned, the importance of the role of TIS has been underlined. TIS is one participant who is very close to the core of the project. Its role is to cross analyse information coming from different sources during all phases of a project (e.g. QS on all subjects as well as plans, calculation notes).

His task will for instance contribute to assess the adequacy of technical solutions to local context, to evaluate the incidence of the incorporation of a system on performances of building works, (e.g. evacuation of rain water for a specific type of façade, behaviour of a thermal insulation system in a windy context, water tightness of roofs where PV panels are incorporated).

The mission of TIS is in adequacy with the importance of projects and associated risks. The relevance of QS for an insurer depends on the project context (e.g. importance, technical complexity). It is independent of the regulatory context.

6 Complementarity and compatibility of CE marking with other QS

Complementarity and compatibility issues of CE marking with other QS **only concern construction products.** There are a priori no interferences between CE marking and other QS considered within the framework of the ELIOS2 project (i.e. individual/company competences, construction systems, building works).

One of the positive outcomes of the development of CE marking is its contribution to defining a common language through EU-28 countries when addressing questions concerning performances of

construction products. The CPR entered into force on 2013/07/01. It initiated changes in the construction industry that will take some time to be completed.

In the meantime a better understanding of the consequences of the CPR implementation still has to be addressed as some misconceptions do persist. Comparison between the scope of CE marking and the scope of other QS participate in the implementation of the CPR by explaining differences and synergies (http://en.komo.nl/files/84_engelstalige-leaflet.pdf).

Necessary debates are going on to better explain pros and cons related to CPR. Appendix R intends to highlight pending questions that have to be addressed through a constructive discussion between the concerned construction actors and the Commission.

Concerning this latter point, a comparison was presented during the second ELIOS2 forum between the information conveyed by CE marking and other QS concerning two products: cements and ceramic tiles adhesives (Figure 14).

Figure 14 : example of comparison of information conveyed by CE marking and other QS

product	CE marking	Non-mandatory QS
Ceramic tile adhesives	**AVCP- System 3** - Tensile resistance	**3rd party conformity assessment** - Tensile and shear resistances - Open time - Compatible substrates - Type of coating (simple/double) - Short term (6h) adhesion capacity
Cements	**AVCP - System 1+ (two months audit-testing)** - Mechanical resistances - Physical + chemical char.	**3rd party conformity assessment (monthly audit-testing)** - Mechanical resistances - Physical + chemical char. - Specific use - Specific composition

AVCP : assessment and verification of constancy of performance

Differences in information content do exist. They reflect needs of construction actors to have access to relevant information that are not addressed by harmonised standards. This fact should be acknowledged in order to record progresses in the CPR implementation.

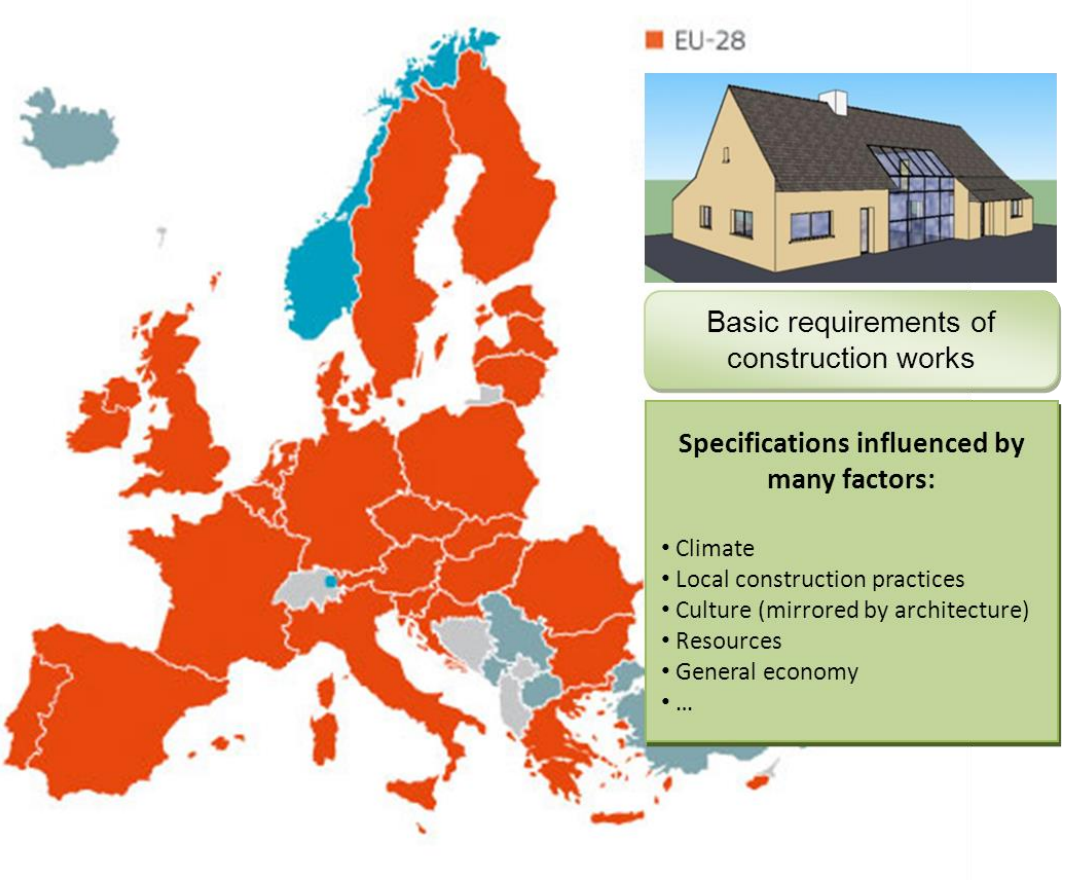
When barriers to trade are fully removed through the application of the CPR, it remains important to recall that, as stated in 3.2, the selection of “ideal” construction products cannot guarantee building works will perform as expected. It is a long and complex way to go from construction products to construction works in operation.

There are many technical construction systems likely to satisfy basic requirements of construction works as they are specified by a construction programme. Moreover, the detailed expression of these requirements highly depends on contextual parameters (Figure 15). This characteristic of the construction activity reinforces the importance for local construction actors of having access to information on construction products and systems that are closely linked to the local contexts.

The recent European Union Public Procurement Directive (EUPPD) should also be considered in the above mentioned constructive exchanges with the Commission. Recitals 74 and 75 of this directive make clear statements concerning the opportunity to use third party QS among other means to prove equivalence with a label requested by a public client for a technical solution. This Directive also intends to promote the use of performance based approach to favour the emergence and use of innovative solutions.

The outcomes of the on-going survey on relevance and impacts of QS on the performance of the construction industry (chapter 0) will also bring elements for further exchanges.

Figure 15 : factors influencing the detailed specifications of basic requirements



7 Impact and relevance of QS: electronic survey

7.1 Goal of the survey

The survey aims to assess the relevance and impacts of QS on the performance of the construction industry. The scope of QS addressed in the survey is not limited to QS concerning the four subjects selected for the directory of QS (products, systems, competences, works). This short list was decided in order to stick to the call for tender stipulating the "*Development of an EU directory on quality/conformity marks (labels, certificates, technical assessment, etc.) for construction products, processes, works, technical equipment and professional qualifications.*"

The objective of the survey is then to question other issues such as:

1. the reliability of QS such as reputation, first-party certification, second-party certification, third-party certification and on-site inspections.;
2. the influence of QS on items such as pathology, safety, energy performance of buildings;
3. the impact of the QS on the competitiveness of the industry;
4. the motivation for applying for a QS for products and systems;
5. the use of QS by the insurance sector.

7.2 Methodology

The survey targets five categories of actors: 1) suppliers, 2) architects/technical designers, 3) contractors, 4) clients and 5) people working for the insurance sector. The electronic survey is based on the platform provided by the software company Survey Monkey (https://fr.surveymonkey.com/). The survey is planned to be followed by phone interviews with construction practitioners and insurer representatives. It was sent to key stakeholders in selected countries.

A draft questionnaire was developed by CSTB, tested by the other partners of the consortium and presented to forum members. An amended final version was put on line on the platform provided by Survey Monkey.

Three versions of the same questionnaire were developed: one in English, one in French and one in Romanian. For each questionnaire, a different approach was followed to reach the targeted population:

- CSTB database was used for the survey in French. About 22 000 French speaking actors belonging to the targeted population were contacted[4] and were likely to answer online to the questionnaire
- The English questionnaire (Appendix A) was firstly sent to the actors who subscribed to the ELIOS newsletter and to list people provided by some members of the consortium. After Forum 6 in Brussels a new method was used. Suppliers, architects/technical designers, contractors, clients and people working for the insurance sector could answer to the questionnaire by clicking on an Internet link. Then members of the consortium, international federations (such as FIEC - The European Construction Industry Federation) and international

[4] It is not possible to know the exact number of people reached since several addresses were wrong and people used sometimes two addresses.

networks (ENBRI - European Network of Building Research Institutes – ECCREDI - European Council for Construction Research, Development and Innovation – ECTP – European Construction Technology Platform) were contacted to send the Internet link to their members in order to enlarge the representation of foreign respondants;

- The English questionnaire was translated in Romanian by Alina COBZARU, a senior researcher working at the national institute INCD URBAN-INCERC (Institutul Naţional de Cercetare-Dezvoltare in Construcţii). Alina COBZARU sent the Romanian questionnaire (Word format) by emails to members of her network. All questionnaires which were filled were redirected to CSTB (PDF files). Then each file was entered into the the platform provided by SurveyMonkey.

The preparation of this survey underestimated the difficulty to contact professionals. The assumption ELIOS2 partners and some forum members could easily take over the dissemination of the survey happened to be less fruitful than expected. Some did the efforts and must be thanked for this (FIEC). No budget had been anticipated to hire services of specialised polling organisms. The wording of questions could have also been improved.

The predominance of French respondents does not allow robust conclusions for the whole Europe but at least shows some tendencies concerning the way different groups of professionals do trust or give “value” to different QS.

7.3 Analysis of responses

A total of 889 answers were recorded (Table 2). Some of these answers were discarded for various reasons (incomplete, lack of coherency, randomly filled in). Moreover, the people who replied and did not belong to one of the five categories of the study were expelled from the online survey. Finally, 600 French answers, 38 answers from Romania and from other EU-28 countries were usable.

The over representation of France has three main reasons. First, the availability of a great number of email addresses. This was not the case for other EU-28 countries in spite of the efforts of contacted organisms. Second, the language issue is a difficulty. Without the unexpected initiative to translate in Romanian language, the chance to get answer would have not been so high in this country. Third, most contacted organisations argued that they do not wish to take over the dissemination of a survey they have not designed (even if they share the interest for the topic).

This over representation of one group of respondents creates a difficulty when analysing results.

About 75% of respondents have more than 10 years of experience. The majority also employs less than 10 people (36%) and has a turnover below 2 million € (45%). This is mainly due to architects and technical designers who represent one third of respondents and are small structures employing usually less than 10 people. Suppliers, clients and insurers are larger. About 43% of them employ more than 250 employees and have a turnover above 50 million euros. Contractors are scattered among the different categories and respondents are larger than average contractors. Indeed, in all European countries, contractors with less than 10 employees represent at least 90% of the firms of this category. More details on the experience of respondents, turnover and size of companies are available in appendix B.

Table 2 : Sample of answers to online questionnaire

	France	Romania	Rest of EU	Total
Supplier	188 (24%)	10 (26%)	9 (17%)	207
Architect/technical designer	311(39%)	9 (24%)	13 (24.5%)	333
Contractor	144 (18%)	13 (34%)	4 (7.5%)	161
Client	115 (14%)	3 (8%)	6 (11.5%)	124
Insurer	31 (4%)	3 (8%)	13 (24.5%)	47
Other	9 (1%)	0	8 (15%)	17
Total	798	38	53	889

41% of the respondents have professional activities outside the country of the head-office of the company (Table 3). Two third of suppliers and insurers develop some business outside their national market. This element the impact of quality sign on cross border activities, this issue will be examine

Table 3 : Activities in foreign country

	France					Romania	Rest of EU	Total	%
Operation in foreign country	**Supplier**	**Architect/ technical designer**	**Contrac-tor**	**Client**	**Insurer**				
Yes	125 (66%)	105 (34%)	38 (26%)	23 (21%)	20 (67%)	13 (34%)	29 (64%)	353	41
No	63 (34%)	206 (66%)	106 (74%)	87 (79%)	10 (33%)	25 (66%)	16 (36%)	513	59
Total	188	311	144	110	30	38	45	866	100

7.3.1 Relevance of quality signs

Methodology

As it was mentioned earlier quality signs are supposed to send a distinctive signal to the market and to bring trust among construction stakeholders. The final aim is to reduce costs and counter-performances. However, quality signs in construction are quite numerous. This diversity might bring confusion.

Consequently, the five categories of actors were asked to rank several quality signs on a scale going from 1 to 6 (1 being "no trust", 6 being "high trust"). Quality sign was defined as "*any kind of sign on the basis of which (construction) stakeholders rely on or give credit to when decisions or choices have to be made.*" For the analysis, levels were paired: 1 and 2; 3 and 4; 5 and 6.
Nine elements contributing to quality signs have been identified for the sake of the study:

- Branding,
- On-site inspections with an independent person throughout the production process of the construction product, (factory inspection),
- Technical approval,
- On-site inspections with an independent person throughout the production process of the construction work, (construction site inspection),
- CE marking,
- Reputation[5],

[5] Reputation differs from branding. Branding is a marketing practice dedicated to the creation of name, symbol or design in order to identify and differentiate a product from other products. Reputation is more the result of

- First party certification (in this case conformity assessment activity is performed by the person or organization that provides the object),
- Second party certification (in this case conformity assessment activity is performed by a person or organization that has a user interest in the object),
- Third party certification (person or body that is recognized as being independent of the parties involved).

The aim of the analysis was twofold:

1. to evaluate the reliability of the aforementioned elements contributing to quality signs,
2. to examine how actors from the panel evaluate those elements.

The answers obtained from the online survey were expressed in a contingency table in order to assess whether observations, were independent of each other (Pearson's chi-squared test (χ^2) – appendix C). Two types of tests were used:

- Firstly, the aim was to examine if one's nationality is related to the response (trust on elements contributing to quality signs). However, due to the restricted numbers of observations outside France, it was decided to gather the answers in three categories of countries: France, Romania and the rest of Europe (table 5). At this level, two tests were developed:
  - one with the three groups of countries together and
  - a second restricted to France and the rest of Europe.

  Indeed, table 4 indicates that Romanian actors' answers were different from the other groups. They tend to express a high level of trust with most elements contributing to quality signs[6]. This was not the case for French and other European participants to the survey.
- Secondly, responses from different categories of actors were polled in order to see whether the activity was related to the judgement on elements contributing to quality signs. Due to the restricted number of observations for each category of actors for the foreign samples (Romania and the rest of Europe), it was only possible to do this analysis with the French sample.

Results

- The level of trust given to the nine elements contributing to quality signs is dependent from the countries (when the test is used with three countries at 1% significance level – the significance level is only 5% for "third party certification").
  The chi-squared test excluding the Romanian sample, indicated independency between the nationality and the level of trust in several elements contributing to quality signs (at 5% significance level): "branding", "first party certification", "second party certification", "third party certification", "reputation", "CE marking". It means that there is no relationship between the nationality and the level of trust given to those elements (each group of country has the same opinion).
  Conversely, dependency was proved for "technical approval" and "On-site inspections with an independent person throughout the production process of the construction work /

a social evaluation. Very small companies (particularly in construction) do not spend money to develop their brand. However, they always try to main their reputation/image.

[6] This was confirmed by a Pearson's chi-squared test (χ^2) for independence which examines how nationality is related to the response.

product". In those cases, the nationality has an influence on the level of trust. All tables with observed frequency and p. value are reproduced in appendices D and E.

- The relationship between the activity (role of the respondent in the construction supply chain) and the level of trust in elements contributing to quality signs was also examined at the French level (appendix F).[7]
  There was a relationship for "branding", "technical approval", "first party certification" and "second party certification" (1% significance level), "reputation" and "third party certification" (5% significance level). In those cases, actors evaluate differently quality signs. For example, "branding" is valued by suppliers while architects/technical designers do not attach great importance to this sign. Indeed, branding is a marketing practice that appears to be better adapted to suppliers who sell services/products than to architects.
  Conversely, there was no relationship between the activity and the level of trust for the following elements contributing to quality signs: "on-site inspections with an independent person throughout the production process of the construction product/work" and "CE marking".
- "On-site inspections with an independent person throughout the production process of the construction product / work" are considered as the most relevant element contributing to quality signs (table 4). Actors from the rest of Europe ranked it first[8]. This situation apparently results from the over representation of insurers in this sub-sample. Indeed, insurers represent one third of the respondents (13 out of 38). As in France, they rely more on on-site inspections. They consider that it is the best way to monitor the quality. This was also confirmed by interviews. Insurers consider that certifications are reliable. However, they are delivered at a certain point of time and when time goes on, the situation within every certified company may change. It makes the difference with on-site-inspections with an independent person, which are the best way to reduce building defects and the risk that they bear as insurers.
- "CE marking" is ranked the highest in Romania (table 5). In this country, it appears that certification and quality signs dedicated to the construction industry started about 20 years ago. Thus, no national sign was in place and appreciated by the actors. Conversely, most Western countries had a longer tradition with certification procedures and quality as a source of competitive advantage on the international market. Most of the time, in those countries the quality sign system was considered as more reliable since it provides better information. This is confirmed by the evaluation of quality of CE marking for construction products (appendix G).

7.3.2 Impact of quality signs

Most of the actors interviewed share the same views on the influence of quality signs concerning construction products, construction systems, competences of people/companies and buildings.

[7] We could assume that French actors working only in France would rate differently quality signs. However, according to a statistical analysis, both samples of actors share the same definition as long as quality sign is concerned.

[8] The chi-squared test indicated independency between the nationality and the level of trust for these signs.

There is no relationship between the nationality of the actors surveyed and the way they perceive the influence of quality signs when the tests are limited to two samples ("France" and "the rest of Europe" - appendices H to K which show that the P-value is most of the time higher than 0.05 when the analysis is limited to these two samples). It means that most European actors share the same views (Romanian actors being the exception). We could assume that similar views would be shared by most countries who were previously member of the eastern bloc.

Similarly, the null hypothesis is always accepted (P-value above 0.05) when the analysis examines the relationship between the activity of the actors surveyed and their perception of the impact of quality signs (appendices L to O)

Most actors agree to affirm that the strongest impact is on safety and energy performance of buildings (table 6). The impact on pathology reduction is comparatively lower and the effect on insurance costs appears quite weak.

Quality signs are also perceived as a stimulus for business by more than 40% of the respondents of the survey (appendix P). Moreover, a majority considers that it is not a source of protectionism. (Table 4 – appendix P). However, while the nationality does not have an influence on this opinion, the activity does (P-value = 0.0215). More than half of the suppliers of the sample perceive quality signs as a barrier to trade. This category is also probably the most exposed to the international competition among the five.

Table 4 : Quality signs as a source of protectionism

	Supplier (France)	Architect/technical designer (France)	Contractor (France)	Client (France)	Insurer (France)	Romania	Rest of Europe	Total
Yes	63 (52%)	72 (36%)	35 (39%)	17 (25%)	6 (30%)	12 (31%)	9 (29%)	214 (38%)
No	48 (40%)	101 (50.5%)	46 (51%)	41 (60.3%)	13 (65%)	17 (45%)	19 (61%)	285 (50%)
No opinion	10 (8%)	27 (13.5%)	9 (10%)	10 (14.7%)	1 (5%)	9 (24%)	3 (10%)	69 (12%)
Total	121	200	90	68	20	38	31	568

P-value (France by actors): 0.0215
P-value (France, Romania, rest of Europe): 0.1554

Suppliers apply for quality signs to fulfil the demand of the design team and the client. Internal reasons are also dominant. Applying for quality signs also brings some advantages. It is a source of competitive advantage and it improves the image of the company. However, the impact on R&D and innovation appears more limited. The procedure leading to quality signs is also considered as expensive by three-quarter of the French respondents (appendix Q).

In a second step, the procedure was improved to more easily contact people. A link was send to representatives of several organisations representing either European or national federation/association of stakeholders of the construction industry (e.g. FIEC, ECTP, ENBRI). Moreover, members of the ELIOS project were asked to send this link of the survey to their national partners belonging to the five categories.

Table 5: Relevance of the following elements contributing to quality signs (all categories)

1 being "no trust" 6 being "high trust"	1-2			3-4			5-6			No opinion (all EU)	Total		
	France	Romania	Rest of EU	France	Romania	Rest of EU	France	Romania	Rest of EU		F	R	R. of EU
Branding	58 (10%)	0	7 (18%)	262 (44%)	9 (23%)	12 (32%)	268 (45%)	24 (63%)	16 (42%)	20	600	38	38
On-site inspections with an independent person throughout the production process of the construction product	63 (10%)	0	3 (8%)	211 (35%)	6 (16%)	4 (11%)	298 (50%)	30 (79%)	29 (76%)	32	600	38	38
Technical approval	39 (7%)	0	1 (3%)	217 (36%)	8 (21%))	6 (16%)	336 (56%)	25 (66%)	30 (79%)	14	600	38	38
On-site inspections with an independent person throughout the production process of the construction work	37 (6%)	0	2 (5%)	200 (33%)	8 (21%)	5 (13%)	352 (59%)	27 (71%)	29 (76%)	16	600	38	38
CE marking	177 (29%)	1 (3%)	6 (16%)	267 (45%)	11 (29%)	19 (50%)	143 (23.8%)	23 (61%)	12 (32%)	17	600	38	38
Reputation	67 (11%)	0	2 (5%)	315 (53%)	8 (21%)	19 (50%)	211 (35%)	27 (71%)	15 (39%)	12	600	38	38
First party certification (in this case conformity assessment activity is performed by the person or organization that provides the object)	144 (24%)	1 (3%)	10 (26%)	327 (54%)	20 (52%)	19 (50%)	84 (14%)	16 (42%)	7 (18%)	48	600	38	38
Second party certification (in this case conformity assessment activity is performed by a person or organization that has a user interest in the object)	78 (13)	1 (3%)	5 (13%)	306 (51%)	11 (29%)	17 (45%)	165 (27%)	26 (68%)	13 (34%)	54	600	38	38
Third party certification (person or body that is recognized as being independent of the parties involved)	44 (7%)	0	1 (3%)	181 (30%)	6 (16%)	10 (26%)	331 (55%)	29 (76%)	26 (68%)	48	600	38	38

Table 6 : Influence of quality signs concerning construction products (All)

1 being "weak" 6 being "high"	France	Romania	Rest of EU	France	Romania	Rest of EU	France	Romania	Rest of EU	All EU	
	1-2			3-4			5-6			No opinion	Total
Pathology reduction	50 (10%)	1 (3%)	4 (13%)	211 (42%)	17 (45%)	11 (37%)	187 (38%)	17 (45%)	10 (33%)	59	567
Safety	21 (4%)	0	2 (7%)	209 (42%)	7 (18%)	9 (30%)	244 (49%)	31 (82%)	17 (57%)	27	567
Insurance costs	84 (17%)	1 (3%)	6 (20%)	203 (41%)	14 (37%)	11 (37%)	112 (22%)	18 (47%)	8 (27%)	110	567
Insurance cover	78 (16%)	3 (8%)	5 (17%)	191 (38%)	13 (34%)	10 (33%)	122 (24%)	18 (47%)	9 (30%)	118	567
Energy performance of buildings	36 (7%)	1 (3%)	3 (10%)	165 (33%)	8 (21%)	9 (30%)	275 (54%)	29 (76%)	16 (53%)	25	567
Introduction of innovation	66 (13%)	2 (5%)	7 (23%)	209 (42%)	8 (21%)	8 (27%)	191 (38%)	26 (68%)	11 (37%)	39	567

8 Conclusion

Construction is generally considered as a traditional sector. Nevertheless construction actors have for long been mixing traditional and innovative solutions for both new and existing building works. The quest for excellence in terms of (not only energy) performances and sustainability is reinforcing this essential challenge of the construction industry.

Significant research efforts have been done worldwide and particularly in Europe through many projects addressing several aspects of sustainability on construction. These projects reflect the complexity of the question and allow concluding high performances buildings are only one aspect of the sustainability approach.

Moreover, the achievement of high performance does not result from the addition of individual high performances of products/systems/building parts but is the outcome from the perfect compatibility of all performances, especially at interfaces during design and site phases as well as at physical interfaces between buildings parts.

The construction process organisation is prone to non-quality issues. The number of possible technical solutions is very high so that many new interfaces problems can emerge from one project to another. Furthermore the flow of information during any project is huge and the risk of mis-communication is quite unavoidable between members of a temporary team.

Progresses are expected through a better organisation and communication. Improvements will reduce the asymmetry of information between parties and create a better context to limit the occurrence of risky situations.

Quality signs (QS) are one of the elements that aim to contribute to such improvements. The information carried by QS has to be adapted to construction actors and to their role in the construction process. The needs of designers, of contractors, of insurers are not the same.

Designers need reliable and trustable detailed technical information on products and systems to design building works. Contractors also need reliable and trustable detailed technical information to organise the activity on site, they will then be interested in necessary competences of individual or companies. Insurers need reliable, trustable and discriminant information to assess risks associated to the incorporation of a construction system.

The experience of all these different actors makes them knowledgeable to select adequate QS. Information for any construction project is nevertheless far from being limited to information conveyed by QS. In particular, insurers will mandate technical inspection surveyors (TIS) to have watchful eyes on risky projects from the early design plans to the hand-over not forgetting crucial moments during the erection phase.

The survey concerning the use of QS provides answers about the actual use of QS by clients, architects/technical designers, manufacturers, contractors and insurers also aims to assess the characteristics of QS that build trust. The predominance of French respondents does not allow robust conclusions for the whole Europe but at least shows some tendencies concerning the way different groups of professionals do trust or give “value” to different QS.

Further investigations via phone interviews will confirm these tendencies or bring new elements. From contacts with insurers, a strong tendency is that they favour QS concerning competences. This is consistent with the fact design and execution errors are a major cause of building defect. QS on construction products happen to be less relevant for insurers as products are more rarely a source of building defect.

A specific attention is paid by insurers on QS concerning construction systems as defined in the ELIOS2 project. Such QS may indeed carry discriminant information that is useful for insurers to assess their risk (adequacy of the projected use of the system to its scope and limits as assesses by TA, necessary competence to ensure an appropriate implementation of the system).

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Appendix A: Electronic survey structure

Electronic survey presentation

Survey on quality signs in the construction industry

Framework of the survey

The ELIOS2 project is funded by the European Commission's Enterprise and Industry Directorate-General and its fundamental aim is to "Facilitate access to insurance by self-employed builders and small building firms so as to stimulate innovation and the promotion of eco-technologies in the European Union". More information can be found here: http://www.elios-ec.eu/

The study team is composed of Allianz (Germany), Alten (France), Apave (France), BBRI (Belgium), CEA (France), CSTB (France), Hannover Re (Germany), NHBC (the UK), PRC-Arcadis (the Netherlands), SBI (Denmark) and TZUS (Czech Republic). The partner countries are representative of different types of construction industry within the EU.

Within the Elios 2 team, CSTB is the leader of the Work Package 1 dealing with the elaboration of EU directory on quality signs. CSTB is also in charge of this survey which aims to assess the relevance and impact of the quality signs on the performance of the construction industry.

You have been identified as a competent person of the construction industry / (re)insurance sector
The questionnaire should take around 15 minutes to complete and your time is greatly appreciated. If you are interested, we would be more than happy to share the final report which will outline the results of the survey.

If you need any clarification or further information, please do not hesitate to be in touch with Frédéric BOUGRAIN at CSTB. We look forward to receiving your answers and thank you for your time.

On behalf of the partners,

Frédéric BOUGRAIN

Tel: +33 140502904, Email: frederic.bougrain@cstb.fr

Characteristics of the respondent

1. Your name and email address

Your name and email address Family name

Name of organisation

Email contact details

2. Role of your company in the construction supply chain

Role of your company in the construction supply chain Supplier

- Contractor
- Client/owner/developer
- Architect/Technical designer
- Insurance sector
- Other

3. Your experience in the construction industry

Your experience in the construction industry Less than 5 years

- 5 to 10 years
- More than 10 years

4. In which country do you work?

In which country do you work?

5. Annual turnover of your company

Annual turnover of your company Less than 2 million Euros

- Between 2 and 10 million Euros
- Between 10 and 50 million Euros
- More than 50 million Euros

6. Number of employees in your company

Number of employees in your company 0-9 | 10-49 | 50-249 | More than 250

7. Does your company operate outside your country?

Does your company operate outside your country? Yes | No

Relevance of quality signs

The ELIOS2 project defines quality sign as “any kind of sign on the basis of which (construction) stakeholders rely on or give credit to when decisions or choices have to be made.”
In the ELIOS2 project quality signs can concern construction products, construction systems, competences of companies/people and construction works (buildings).

8. How reliable are the following elements contributing to quality signs? Please rank on a scale going from 1 to 6? (1 being "no trust", 6 being "high trust")

	1	2	3	4	5	6	No opinion
Branding							
On-site inspections with an independent person throughout the production process of the construction product/							
Technical approval							
On-site inspections with an independent person throughout the production process of the construction work/							
CE marking/							
Reputation							
First party certification (in this case conformity assessment activity is							

performed by the person or organization that provides the object)/							
Second party certification (in this case conformity assessment activity is performed by a person or organization that has a user interest in the object)							
Third party certification (person or body that is recognized as being independent of the parties involved)							

9. How do you evaluate the quality of CE marking for construction products on the following two criteria? Please rank on a scale going from 1 to 6 (1 being "very insufficient", 6 being "very satisfying")

	1	2	3	4	5	6	No opinion
The level of details							
The relevance of the information							

Impact of quality signs

10. Please, could you rate on a scale going from 1 to 6, the influence of quality signs concerning construction products on the following topics (1 being "very weak" and 6 being "very strong")? Construction products means "any product or kit which is produced and placed on the market for incorporation in a permanent manner in construction works or parts thereof" - *European Regulation n°305/2011* laying down harmonized conditions for the marketing of construction products.

	1	2	3	4	5	6	No opinion
Pathology reduction/							
Safety of building							
Insurance costs							
Insurance cover							

The energy performance of buildings							
The introduction of innovation							

11. Please, could you rate on a scale going from 1 to 6, the influence of quality signs concerning construction systems on the following topics (1 being "very weak" and 6 being "very strong")?
Construction systems are the ways in which materials are combined to construct the elements of a building e.g. "technical equipment system are technical equipment for the heating, cooling, ventilation, hot water, lighting or for a combination thereof, of a building or building unit" - Directive 2010/31/EU on the energy performance of buildings.

	1	2	3	4	5	6	No opinion
Pathology reduction							
Safety of building							
Insurance costs							
Insurance cover							
The energy performance of buildings							
The introduction of innovation							

12. Please, could you rate on a scale going from 1 to 6, the influence of quality signs concerning competences of companies/people on the following topics (1 being "very weak" and 6 being "very strong")?
Competence is the ability to apply knowledge and skills to achieve intended results.

	1	2	3	4	5	6	No opinion
Pathology reduction/							
Safety of building							
Insurance costs							
Insurance cover							
The energy performance of buildings							

	1	2	3	4	5	6	No opinion
The introduction of innovation							

13. Please, could you rate on a scale going from 1 to 6, the influence of quality signs concerning buildings on the following topics (1 being "very weak" and 6 being "very strong")?

	1	2	3	4	5	6	No opinion
Pathology reduction							
Safety of building							
Insurance costs							
Insurance cover							
The energy performance of buildings							
The introduction of innovation							

14. Could you rate on a scale going from 1 to 6, the degree of protection against competing companies attached to quality signs for construction product/system (1 being "very weak" and 6 being "very strong")?

1	2	3	4	5	6	No opinion

15. Do you think quality signs have an influence on cross-border activities in the construction industry?

Yes and it is a barrier to business	Yes and it has a stimulating influence	No	No opinion

16. Do you consider quality signs as a source of protectionism between countries?

Yes	No	No opinion

Complementary questions

17. Do you consider that the delivery process of quality sign for products/systems? (suppliers)

	Yes	No	Non applicable/
Is a source of competitive advantage on the			

	Yes	No	Non applicable/
market/			
Stimulates R&D			
Stimulates innovation			
Improves the image of your company			
Is expensive			
Creates value for money			

18. Does this process improve the quality of?

	Yes	No	Non applicable
Your products/systems			
Your organization			

19. What is the main motivation for applying for a quality sign for your products/ systems/ competences?

☐ Demand of the client
☐ Demand of the architect/designer
☐ Demand of the technical inspection services
☐ Demand of the insurance system
☐ Internal demand
☐ Non applicable

20. On call for tenders, do you select contractors according to certified qualification? (Clients)

Yes	No

21. On call for tenders, do you consider that you suffer from information asymmetry? (Information asymmetry refers to a situation in which at least one party to a transaction has relevant information whereas the other(s) do not.)

Yes	No	No opinion

22. Does risks assessment for a specific construction project take into account quality signs on?

	Yes	No	Non applicable/
Construction products			
Construction systems			

	Yes	No	Non applicable/
Construction works			
Competencies of people/companies			

23. Would you be willing to be contacted again if we wished to follow up any points?

Yes	No

24. Could you please provide us with the following information?

Name	
Telephone contact details Detalii de contact Telefon	
Email contact details	

Many thanks for your contribution

Appendix B: Characteristics of the respondents

Experience

	France					Romania	Rest of EU	Total	%
	Suppliers	Architect/technical designer	Contractor	Client	Insurer				
Less than 5 years	17 (9%)	36 (12%)	12 (8%)	11 (10%)	1 (3%)	4 (10.5%)	4 (9%)	85	10
5 to 10 years	20 (11%)	63 (20%)	32 (22%)	16 (15%)	9 (30%)	3 (8%)	4 (9%)	147	17
More than 10 years	151 (80%)	212 (68%)	100 (70%)	83 (75%)	20 (67%)	31 (81.5%)	37 (82%)	634	73
Total	188	311	144	110	30	38	45	866	100

Turnover

	France					Romania	Rest of EU	Total	%
Turnover	Supplier	Architect/technical designer	Contractor	Client	Insurer				
Less than 2 million Euros	22 (12%)	227 (73%)	72 (50%)	28 (25%)	12 (40%)	15 (40%)	12 (27%)	388	45
Between 2 and 10 million Euros	32 (17%)	49 (16%)	20 (14%)	15 (14%)	1 (3%)	13 (34%)	6 (13%)	136	15.5
Between 10 and 50 million Euros	49 (26%)	17 (5%)	21 (15%)	22 (20%)	3 (10%)	7 (18%)	8 (18%)	127	14.5
More than 50 million Euros	85 (45%)	18 (6%)	31 (21%)	45 (41%)	14 (47%)	3 (8%)	19 (42%)	215	25
Total	188	311	144	110	30	38	45	866	100

Employees

	France					Romania	Rest of EU	Total	%
Employees	**Supplier**	**Architect/technical designer**	**Contractor**	**Client**	**Insurer**				
0 - 9	14 (7%)	200 (64%)	56 (39%)	18 (16.5%)	10 (33%)	9 (24%)	8 (18%)	315	36
10 – 49	43 (23%)	55 (18%)	35 (24%)	17 (15.5%)	3 (10%)	10 (26%)	11 (24%)	174	20
50 - 249	51 (27%)	32 (10%)	21 (15%)	22 (20%)	4 (13%)	12 (32%)	10 (22%)	152	18
More than 250	80 (43%)	24 (8%)	32 (22%)	53 (48%)	13 (43%)	7 (18%)	16 (36%)	225	26
Total	188	311	144	110	30	38	45	866	100

Appendix C: The Pearson's chi-squared test (χ2) for independence

The Pearson's chi-squared test (χ^2) for independence is used to determine whether there is a significant association between two variables.

For example, in our case, companies surveyed were classified by activity and reliability in elements contributing to quality signs (low trust, trust, high trust). In this case a chi-square test was used to determine whether activity is related to quality signs.

The first step was to state the hypotheses:

a) The null hypothesis states that knowing the level of variable A does not help you to predict the level of variable B (the variables are independent);

b) The alternative hypothesis states that knowing the level of variable A can help to predict the level of variable B (the variables are not independent).

The value of the test-statistic is defined by the following equation:

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

Where: O_i is an observed frequency, E_i, an expected (theoretical) frequency (estimation of how the data should be distributed if the hypothesis of independence is correct) and n = the number of cells in the table.

Observed frequency

Branding	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	5	48	89	142
Architects	33	119	82	234
Contractors	11	47	50	108
Clients	8	38	37	83
Insurers	1	10	10	21
TOTAL	58	262	268	588

Theoretical frequency

Branding	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	14,01	63,27	64,72	142
Architects	23,08	104,27	106,65	234
Contractors	10,65	48,12	49,22	108
Clients	8,19	36,98	37,83	83
Insurers	2,07	9,36	9,57	21
TOTAL	58	262	268	588

In this case the p value is 0.0001. This is interpreted as a 0.01% likelihood that the null hypothesis is rejected. Thus, if the distribution of this data is entirely due to chance, then one has a 0.01% chance of finding a discrepancy between the observed and expected distribution that is at least this extreme.

Consequently, in this case, the null hypothesis is rejected and we can conclude that there is a relationship (variables are not independent) between the level of trust toward branding and the activity of the actors surveyed.

Appendix D: Evaluation of the reliability of several elements contributing to quality signs by nationality (France, Romania, rest of Europe)

Evaluation of branding by nationality

Branding	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	58	262	268	588
Romania	0	9	24	33
Rest of Europe	7	12	16	35
Total	65	283	308	656

P-value : 0.0055

Evaluation of technical approval by nationality

Technical approval	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	39	217	336	592
Romania	0	8	25	33
Rest of Europe	1	6	30	37
Total	40	231	391	662

P-value : 0.0095

Evaluation of reputation by nationality

Reputation	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	67	315	211	593
Romania	0	8	27	35
Rest of Europe	2	19	15	36
Total	69	342	253	664

P-value : 0.00003

Evaluation of on site inspections (construction products) by nationality

On-site inspections (construction product)	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	63	211	298	572
Romania	0	6	30	36
Rest of Europe	3	4	29	36
Total	66	221	357	644

P-value : 0.00006

Evaluation of on site inspections (construction works) by nationality

On-site inspections (construction work)	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	37	200	352	589
Romania	0	8	27	35
Rest of Europe	2	5	29	36
Total	39	213	408	660

P-value : 0.0240

Evaluation of CE marking by nationality

CE marking	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	177	267	143	587
Romania	1	11	23	35
Rest of Europe	6	19	12	37
Total	184	297	178	659

P-value : 0.0000008

Evaluation of first party certification by nationality

First party certification	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	144	327	84	555
Romania	1	20	16	37
Rest of Europe	10	19	7	36
Total	155	366	107	628

P-value : 0.00007

Evaluation of second party certification by nationality

Second party certification	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	78	306	165	549
Romania	1	11	26	38
Rest of Europe	5	17	13	35
Total	84	334	204	622

P-value : 0.00006

Evaluation of third party certification by nationality

Third party certification	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	44	181	331	556
Romania	0	6	29	35
Rest of Europe	1	10	26	37
Total	45	197	386	628

P-value : 0.0386

Appendix E: Evaluation of the reliability of several elements contributing to quality signs by nationality (France, rest of Europe)

Evaluation of branding by nationality

Branding	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	58	262	268	588
Rest of Europe	7	12	16	35
Total	65	274	284	623

P-value: 0.1323

Evaluation of technical approval by nationality

Technical approval	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	39	217	336	592
Rest of Europe	1	6	30	37
Total	40	223	366	629

P-value: 0.0145

Evaluation of reputation by nationality

Reputation	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	67	315	211	593
Rest of Europe	2	19	15	36
Total	69	334	226	629

P-value: 0.5039

Evaluation of on site inspections (construction products) by nationality

On-site inspections (construction product)	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	63	211	298	572
Rest of Europe	3	4	29	36
Total	66	215	327	608

P-value: 0.0029

Evaluation of on site inspections (construction works) by nationality

On-site inspections (construction work)	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	37	200	352	589
Rest of Europe	2	5	29	36
Total	39	205	381	625

P-value: 0.0369

Evaluation of CE marking by nationality

CE marking	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	177	267	143	587
Rest of Europe	6	19	12	37
Total	183	286	155	624

P-value: 0.1756

Evaluation of first party certification by nationality

First party certification	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	144	327	84	555
Rest of Europe	10	19	7	36
Total	154	346	91	591

P-value: 0.7157

Evaluation of second party certification by nationality

Second party certification	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	78	306	165	549
Rest of Europe	5	17	13	35
Total	83	323	178	584

P-value: 0.6544

Evaluation of third party certification by nationality

Third party certification	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
France	44	181	331	556
Rest of Europe	1	10	26	37
Total	45	191	357	593

P-value: 0.3271

Appendix F: Evaluation of the reliability of several elements contributing to quality signs by actors (France)

Evaluation of branding by actors (France)

Branding	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	5	48	89	142
Architects	33	119	82	234
Contractors	11	47	50	108
Clients	8	38	37	83
Insurers	1	10	10	21
Total	58	262	268	588

P-value : 0.00012

Evaluation of technical approval by actors (France)

Technical approval	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	15	65	63	143
Architects	12	77	147	236
Contractors	8	39	60	107
Clients	4	31	48	83
Insurers	0	5	18	23
Total	39	217	336	592

P-value : 0.0156

Evaluation of reputation by actors (France)

Reputation	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	13	68	60	141
Architects	31	136	70	237
Contractors	10	48	50	108
Clients	12	45	27	84
Insurers	1	18	4	23
Total	67	315	211	593

P-value : 0.0136

Evaluation of onsite inspections (construction products) by actors (France)

On-site inspections (construction product)	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	17	49	74	140
Architects	23	88	115	226
Contractors	10	44	48	102
Clients	13	22	46	81
Insurers	0	8	15	23
Total	63	211	298	572

P-value : 0.2583

Evaluation of on-site inspections (construction work) by actors (France)

On-site inspections (construction work)	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	6	53	81	140
Architects	15	77	144	236
Contractors	11	32	62	105
Clients	5	30	50	85
Insurers	0	8	15	23
Total	37	200	352	589

P-value : 0.5633

Evaluation of CE marking by actors (France)

CE marking	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	47	61	33	141
Architects	73	110	54	237
Contractors	25	49	30	104
Clients	24	37	22	83
Insurers	8	10	4	22
Total	177	267	143	587

P-value : 0.8528

Evaluation of first party certification by actors (France)

First party certification	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	21	81	31	133
Architects	70	120	28	218
Contractors	22	69	11	102
Clients	23	43	14	80
Insurers	8	14	0	22
Total	144	327	84	555

P-value : 0.0020

Evaluation of second party certification by actors (France)

Second party certification	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	8	77	46	131
Architects	41	122	53	216
Contractors	16	57	27	100
Clients	10	35	35	80
Insurers	3	15	4	22
Total	78	306	165	549

P-value : 0.0041

Evaluation of third party certification by actors (France)

Third party certification	Low trust (levels 1-2)	Trust (levels 3-4)	High trust (levels 5-6)	Total
Suppliers	7	28	96	131
Architects	20	80	121	221
Contractors	8	37	58	103
Clients	9	24	46	79
Insurers	0	12	10	22
Total	44	181	331	556

P-value : 0.0102

Appendix G: Evaluation of the quality of CE marking for construction products (by nationality and actors)

Level of details	France	Romania	Rest of EU	Total
Very insufficient (1-2)	182	2	9	193
Sufficient (3-4)	305	10	13	328
Very satisfying (5-6)	85	25	9	119
Total	572	37	31	640

P-value: 0.000000000000092

Relevance of the information	France	Romania	Rest of EU	Total
Very insufficient (1-2)	185	1	6	192
Sufficient (3-4)	313	12	14	339
Very satisfying (5-6)	70	24	12	106
Total	568	37	32	637

P-value: 0,000000000000000063

Level of details	France	Rest of EU	Total
Very insufficient (1-2)	182	9	191
Sufficient (3-4)	305	13	318
Very satisfying (5-6)	85	9	94
Total	572	31	603

P-value: 0.1011

Relevance of the information	France	Rest of EU	Total
Very insufficient (1-2)	185	6	191
Sufficient (3-4)	313	14	327
Very satisfying (5-6)	70	12	82
Total	568	32	600

P-value: 0.0002

Level of details	Suppliers	Architects	Contractors	Clients	Insurers	Total (France)
Very insufficient (1-2)	32	75	34	33	8	182
Sufficient (3-4)	70	126	58	39	12	305
Very satisfying (5-6)	33	30	13	7	2	85
Total	135	231	105	79	22	572

P-value: 0.0244

Relevance of the information	Suppliers	Architects	Contractors	Clients	Insurers	Total (France)
Very insufficient (1-2)	38	75	35	30	7	185
Sufficient (3-4)	73	130	56	41	13	313
Very satisfying (5-6)	25	24	11	8	2	70
Total	136	229	102	79	22	568

P-value: 0.4883

Appendix H: Influence of quality signs concerning construction products (France, Romania, rest of Europe)

Pathology reduction	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	50	211	187	448
Romania	1	17	17	35
Rest of Europe	4	11	10	25
Total	55	239	214	508

P-value (France, Romania, rest of Europe): 0.5294
P-value (France, rest of Europe): 0.759

Safety of building	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	21	209	244	474
Romania	0	7	31	38
Rest of Europe	2	9	18	29
Total	23	225	293	541

P-value (France, Romania, rest of Europe): 0.0052
P-value (France, rest of Europe): 0.3629

Insurance costs	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	84	203	112	399
Romania	1	14	18	33
Rest of Europe	6	11	8	25
Total	91	228	138	457

P-value (France, Romania, rest of Europe): 0.0117
P-value (France, rest of Europe): 0.8005

Insurance cover	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	78	191	122	391
Romania	3	13	18	34
Rest of Europe	5	10	9	24
Total	86	214	149	449

P-value (France, Romania, rest of Europe): 0.108
P-value (France, rest of Europe): 0.7657

Energy performance of buildings	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	36	165	275	476
Romania	1	8	29	38
Rest of Europe	3	9	16	28
Total	40	182	320	542

P-value (France, Romania, rest of Europe): 0.2284
P-value (France, rest of Europe): 0.8229

Introduction of innovation	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	66	209	191	466
Romania	2	8	26	36
Rest of Europe	7	8	11	26
Total	75	225	228	528

P-value (France, Romania, rest of Europe): 0.0017
P-value (France, rest of Europe): 0.1481

Appendix I: Influence of quality signs concerning construction systems (France, Romania, rest of Europe)

Pathology reduction	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	51	196	203	450
Romania	2	9	24	35
Rest of Europe	4	9	11	24
Total	57	214	238	509

P-value (France, Romania, rest of Europe): 0.0917
P-value (France, rest of Europe): 0.6858

Safety of building	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	25	180	260	465
Romania	0	7	30	37
Rest of Europe	3	9	16	28
Total	28	196	306	530

P-value (France, Romania, rest of Europe): 0.0254
P-value (France, rest of Europe): 0.4428

Insurance costs	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	80	187	121	388
Romania	1	13	19	33
Rest of Europe	5	11	8	24
Total	86	211	148	445

P-value (France, Romania, rest of Europe): 0.0191
P-value (France, rest of Europe): 0.9704

Insurance cover	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	74	194	118	386
Romania	3	11	20	34
Rest of Europe	4	11	9	24
Total	81	216	147	444

P-value (France, Romania, rest of Europe): 0.0201
P-value (France, rest of Europe): 0.7736

Energy performance of buildings	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	29	162	283	474
Romania	1	7	30	38
Rest of Europe	1	9	17	27
Total	31	178	330	539

P-value (France, Romania, rest of Europe): 0.2196
P-value (France, rest of Europe): 0.861

Introduction of innovation	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	59	183	215	457
Romania	2	6	28	36
Rest of Europe	5	7	15	27
Total	66	196	258	520

P-value (France, Romania, rest of Europe): 0.0055
P-value (France, rest of Europe): 0.3183

Appendix J: Influence of quality signs concerning competences of people/companies (France, Romania, rest of Europe)

Pathology reduction	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	48	168	230	446
Romania	1	13	22	36
Rest of Europe	4	11	10	25
Total	53	192	262	507

P-value (France, Romania, rest of Europe): 0.3584
P-value (France, rest of Europe): 0.4819

Safety of building	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	39	162	263	464
Romania	1	8	28	37
Rest of Europe	3	12	13	28
Total	43	182	304	529

P-value (France, Romania, rest of Europe): 0.1488
P-value (France, rest of Europe): 0.5681

Insurance costs	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	84	192	104	380
Romania	2	12	18	32
Rest of Europe	6	9	7	22
Total	92	213	129	434

P-value (France, Romania, rest of Europe): 0.0088
P-value (France, rest of Europe): 0.6764

Insurance cover	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	83	187	106	376
Romania	3	12	18	33
Rest of Europe	6	6	11	23
Total	92	205	135	432

P-value (France, Romania, rest of Europe): 0.0046
P-value (France, rest of Europe): 0.0635

Energy performance of buildings	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	48	159	264	471
Romania	1	7	30	38
Rest of Europe	3	12	12	27
Total	52	178	306	536

P-value (France, Romania, rest of Europe): 0.0453
P-value (France, rest of Europe): 0.4745

Introduction of innovation	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	80	174	206	460
Romania	1	12	23	36
Rest of Europe	5	10	12	27
Total	86	196	241	523

P-value (France, Romania, rest of Europe): 0.1231
P-value (France, rest of Europe): 0.9883

Appendix K: Influence of quality signs concerning buildings (France, Romania, rest of Europe)

Pathology reduction	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	49	193	185	427
Romania	1	11	23	35
Rest of Europe	4	11	8	23
Total	54	215	216	485

P-value (France, Romania, rest of Europe): 0.0715
P-value (France, rest of Europe): 0.5906

Safety of building	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	38	193	214	445
Romania	1	7	28	36
Rest of Europe	2	13	12	27
Total	41	213	254	508

P-value (France, Romania, rest of Europe): 0.0156
P-value (France, rest of Europe): 0.8859

Insurance costs	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	68	203	89	360
Romania	1	10	22	33
Rest of Europe	3	9	10	22
Total	72	222	121	415

P-value (France, Romania, rest of Europe): 0.000006
P-value (France, rest of Europe): 0.0982

Insurance cover	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	68	195	100	363
Romania	2	12	20	34
Rest of Europe	3	7	13	23
Total	73	214	133	420

P-value (France, Romania, rest of Europe): 0.0002
P-value (France, rest of Europe): 0.0121

Energy performance of buildings	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	30	164	256	450
Romania	1	8	29	38
Rest of Europe	2	11	14	27
Total	33	183	299	515

P-value (France, Romania, rest of Europe): 0.2025
P-value (France, rest of Europe): 0.8767

Introduction of innovation	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
France	68	208	162	438
Romania	1	10	25	36
Rest of Europe	7	10	10	27
Total	76	228	197	501

P-value (France, Romania, rest of Europe): 0.0012
P-value (France, rest of Europe): 0.3169

Appendix L: Influence of quality signs concerning construction products (by actors in France)

Pathology reduction	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	21	92	71	184
Architects	14	51	39	104
Contractors	8	34	38	80
Clients	6	25	29	60
Insurers	1	9	10	20
Total	50	211	187	448

P-value: 0.7584

Safety of building	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	9	92	89	190
Architects	6	43	68	117
Contractors	4	37	44	85
Clients	2	26	36	64
Insurers	0	11	7	18
Total	21	209	244	474

P-value: 0.4877

Insurance costs	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	43	77	38	158
Architects	13	47	35	95
Contractors	11	40	19	70
Clients	13	32	12	57
Insurers	4	7	8	19
Total	84	203	112	399

P-value: 0.0827

Insurance cover	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	39	72	42	153
Architects	12	42	39	93
Contractors	11	39	19	69
Clients	12	31	14	57
Insurers	4	7	8	19
Total	78	191	122	391

P-value: 0.1009

Energy performance of buildings	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	17	63	109	189
Architects	8	42	68	118
Contractors	5	33	47	85
Clients	4	17	44	65
Insurers	2	10	7	19
Total	36	165	275	476

P-value: 0.4701

Introduction of innovation	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	27	81	75	183
Architects	18	48	52	118
Contractors	10	46	29	85
Clients	9	25	30	64
Insurers	2	9	5	16
Total	66	209	191	466

P-value: 0.6779

Appendix M: Influence of quality signs concerning construction systems (by actors in France)

Pathology reduction	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	19	89	78	186
Architects	13	45	43	101
Contractors	12	31	37	80
Clients	5	22	37	64
Insurers	2	9	8	19
Total	51	196	203	450

P-value: 0.4815

Safety of building	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	13	79	98	190
Architects	4	36	72	112
Contractors	7	35	40	82
Clients	1	22	41	64
Insurers	0	8	9	17
Total	25	180	260	465

P-value: 0.1610

Insurance costs	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	43	72	43	158
Architects	12	40	37	89
Contractors	12	34	21	67
Clients	9	34	13	56
Insurers	4	7	7	18
Total	80	187	121	388

P-value: 0.0725

Insurance cover	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	39	78	39	156
Architects	10	43	35	88
Contractors	10	36	22	68
Clients	10	32	14	56
Insurers	5	5	8	18
Total	74	194	118	386

P-value: 0.0539

Energy performance of buildings	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	15	62	114	191
Architects	4	42	69	115
Contractors	5	31	49	85
Clients	3	16	45	64
Insurers	2	11	6	19
Total	29	162	283	474

P-value: 0.1492

Introduction of innovation	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	27	69	86	182
Architects	14	43	56	113
Contractors	9	37	37	83
Clients	8	25	31	64
Insurers	1	9	5	15
Total	59	183	215	457

P-value: 0.8174

Appendix N: Influence of quality signs concerning competences of people/companies (by actors in France)

Pathology reduction	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	26	64	93	183
Architects	8	45	50	103
Contractors	9	29	38	76
Clients	4	21	39	64
Insurers	1	9	10	20
Total	48	168	230	446

P-value: 0.4180

Safety of building	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	21	67	100	188
Architects	9	40	63	112
Contractors	7	26	48	81
Clients	2	23	39	64
Insurers	0	6	13	19
Total	39	162	263	464

P-value: 0.5436

Insurance costs	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	45	67	38	150
Architects	11	53	24	88
Contractors	13	32	21	66
Clients	12	31	14	57
Insurers	3	9	7	19
Total	84	192	104	380

P-value: 0.1169

Insurance cover	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	42	68	40	150
Architects	12	53	22	87
Contractors	13	30	22	65
Clients	13	27	15	55
Insurers	3	9	7	19
Total	83	187	106	376

P-value: 0.2496

Energy performance of buildings	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	23	56	111	190
Architects	10	49	57	116
Contractors	8	25	47	80
Clients	3	19	43	65
Insurers	4	10	6	20
Total	48	159	264	471

P-value: 0.0529

Introduction of innovation	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	36	64	83	183
Architects	20	46	48	114
Contractors	11	39	31	81
Clients	8	20	38	66
Insurers	5	5	6	16
Total	80	174	206	460

P-value: 0.1676

Appendix O: Influence of quality signs concerning buildings (by actors in France)

Pathology reduction	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	23	82	76	181
Architects	12	43	42	97
Contractors	10	31	30	71
Clients	4	27	30	61
Insurers	0	10	7	17
Total	49	193	185	427

P-value: 0.7226

Safety of building	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	23	77	84	184
Architects	7	47	53	107
Contractors	6	37	33	76
Clients	2	23	37	62
Insurers	0	9	7	16
Total	38	193	214	445

P-value: 0.1739

Insurance costs	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	38	76	33	147
Architects	11	46	26	83
Contractors	10	33	18	61
Clients	7	35	10	52
Insurers	2	13	2	17
Total	68	203	89	360

P-value: 0.0894

Insurance cover	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	34	79	33	146
Architects	10	44	28	82
Contractors	13	30	22	65
Clients	7	32	14	53
Insurers	4	10	3	17
Total	68	195	100	363

P-value: 0.2657

Energy performance of buildings	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	13	65	104	182
Architects	6	43	60	109
Contractors	8	25	47	80
Clients	2	20	40	62
Insurers	1	11	5	17
Total	30	164	256	450

P-value: 0.2222

Introduction of innovation	Very weak (1-2)	Average (3-4)	Very strong (5-6)	Total
Suppliers	33	78	66	177
Architects	16	53	36	105
Contractors	11	39	31	81
Clients	7	28	25	60
Insurers	1	10	4	15
Total	68	208	162	438

P-value: 0.704

Appendix P: Influence of quality signs on cross-border activities

Influence of quality signs on cross-border activities

	Supplier	Architect/ technical designer	Contractor	Client	Insurer	Romania	Rest of Europe	Total
Barrier to business	31 (26%)	26 (13%)	12 (13.5%)	4 (6%)	6 (30%)	4 (10%)	7 (23%)	90 (16%)
Stimulating influence	51 (42%)	78 (39%)	34 (38%)	27 (39.5%)	8 (40%)	27 (71%)	17 (55%)	242 (42%)
No influence	25 (21%)	29 (14.5%)	21 (23%)	11 (16%)	1 (10%)	1 (3%)	6 (19%)	95 (17%)
No opinion	14 (11%)	67 (33.5%)	23 (25.5%)	26 (38.5%)	4 (20%)	6 (16%)	1 (3%)	141 (25%)
Total	121	200	90	68	20	38	31	568

P-value (France by actors): 0.0002
P-value (France, Romania, rest of Europe): 0.0006

Quality signs as a source of protectionism between countries

	Supplier	Architect/ technical designer	Contractor	Client	Insurer	Romania	Rest of Europe	Total
Yes	63 (52%)	72 (36%)	35 (39%)	17 (25%)	6 (30%)	12 (31%)	9 (29%)	214 (38%)
No	48 (40%)	101 (50.5%)	46 (51%)	41 (60.3%)	13 (65%)	17 (45%)	19 (61%)	285 (50%)
No opinion	10 (8%)	27 13.5%)	9 (10%)	10 (14.7%)	1 (5%)	9 (24%)	3 (10%)	69 (12%)
Total	121	200	90	68	20	38	31	568

P-value (France by actors): 0.0215
P-value (France, Romania, rest of Europe): 0.1554

Degree of protection against competing companies attached to quality signs for construction product/system (1 being "very weak" and 6 being "very strong")

	Supplier	Architect/technical designer	Contractor	Client	Insurer	Romania	Rest of Europe	Total
1 - 2	28 (23%)	38 (19%)	21 (23%)	12 (18%)	3 (15%)	2 (5%)	9 (29%)	113 (20%)
3 - 4	42 (35%)	83 (41%)	39 (43%)	25 (37%)	5 (25%)	23 (61%)	5 (16%)	222 (39%)
5 - 6	45 (37%)	53 (27%)	22 (25%)	13 (19%)	5 (25%)	11 (29%)	12 (39%)	161 (28%)
No opinion	6 (5%)	26 (13%)	8 (9%)	18 (26%)	7 (35%)	2 (5%)	5 (16%)	72 (13%)
Total	121	200	90	68	20	38	31	568

P-value (France by actors): 0.0006
P-value (France, Romania, rest of Europe): 0.008

Appendix Q: Impact / Motivation – Questions specific to suppliers

Impact of the delivery process of quality sign for products / systems

	France (117 answers)			Romania (10 answers)			Rest of EU (5 answers)		
	Yes	No	No relevant	Yes	No	No relevant	Yes	No	No relevant
Source of competitive advantage	100 (85,5%)	16 (13,5%)	1 (1%)	100%	0	0	80%	20%	0
Stimulates R&D	77 (66%)	34 (29%)	6 (5%)	90%	10%	0	40%	60%	0
Stimulates innovation	64 (54,5%)	50 (42,5%)	3 (3%)	90%	10%	0	40%	60%	0
Improves the image of the firm	108 (92%)	9 (8%)	0	100%	0	0	80%	20%	0
Is expensive	85 (72,5%)	23 (19,5%)	9 (8%)	50%	40%	10%	60%	40%	0
Creates value for money	49 (42%)	58 (49,5%)	10 (8,5%)	70%	20%	10%	40%	60%	0
Improves the quality of the products/systems	100 (85,5%)	16 (13,5%)	1 (1%)	100%	0	0	80%	20%	0

Main motivation for applying for a quality sign for your products/systems

	France	Romania	Rest of EU
Demand of the client	59 (50,43%)	5 (50%)	2 (40%)
Demand of the architect/designer	63 (53,85%)	3 (30%)	4 (80%)
Demand of the technical inspection services	48 (41,03%)	6 (60%)	0
Demand of the insurance system	29 (24,79%)	1 (10%)	0
Internal demand	56 (47,86%)	5 (50%)	2 (40%)
No relevant	8 (6,84%)	0	0
Total (number of respondents))	117	10	5

Appendix R: Practical meaning of CE marking for actors in the construction sector – Removing misconceptions

Practical meaning of CE marking for actors in the construction sector – Removing misconceptions

(Eric Winnepenninckx, BBRI)

On 18 January 2011 the European Parliament adopted Regulation (EU) N° 305/2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC. The Council of the European Union did this on 28 February 2011. Twenty days after publication in the Official Journal of the European Union in April 2011, a number of articles came into force, allowing the organizations involved time to adjust to this new regulation, but most articles came into force on 1 July 2013. Since this date manufacturers, distributors and importers have had to adapt to the new situation.

Although the Regulation has been in force for 3 years, limited knowledge and experience exists concerning the impact of the new context. Nevertheless, this chapter endeavours to present a state-of-play and to identify misconceptions that exist amongst many actors in the construction sector.

The acceptance by the European Parliament and the Council of the European Union came at the end of a process that lasted five years. In 2006, the European Commission launched a consultation and a number of studies, and in May 2008 she published her official proposal. This showed that the main objectives of the European Commission were to clarify the meaning of the CE marking, to simplify the procedures and to increase credibility.

Directive 89/106/EEC had to be transposed in national legislation before becoming applicable. A regulation does not require transposition. It is directly applicable in all Member States of the European Union. Nevertheless, most member states had to withdraw and/or modify (parts of) the legislation that transposed the directive. In fact, in most member states complementary legislation will be necessary to specify particular rules for designating and notifying third parties, i.e. certification bodies and laboratories, and to designate technical assessment bodies, to specify penalties related to their market surveillance activities, to designate product contact points, etc.

In fact, in comparison with Directive 89/106/EEC, Regulation (EU) N° 305/2011 is not a dramatic change of direction. The most apparent change is that – contrary to all other legislation leading to CE marking – products are not accompanied by a manufacturer's declaration of conformity, but by a manufacturer's declaration of performance. This document should accompany construction products when they are placed on the market, but since the publication in the Official Journal of the European Union in February 2014, Commission Delegated Regulation (EU) N° 157/2014 of October 30, 2013 on the conditions for the provision of declarations of performance of construction products on a site, it is possible to refer from the CE marking to a declaration of performance that is available through an Internet website. The information accompanying the CE marking is almost the same as before.

The CE marking affixed to toys means that the manufacturer confirms that, in his opinion, the product is in conformity with the requirements contained in the Toy Directive.

The content of the declaration of performance should comply with Annex III of the Regulation. This annex was recently adapted by means of the Commission Delegated Regulation (EU) N° 574/2014 of 21 February 2014 amending Annex III to Regulation (EU) No 305/2011 of the European Parliament and of the Council concerning the model for drawing up a declaration of performance of construction products.

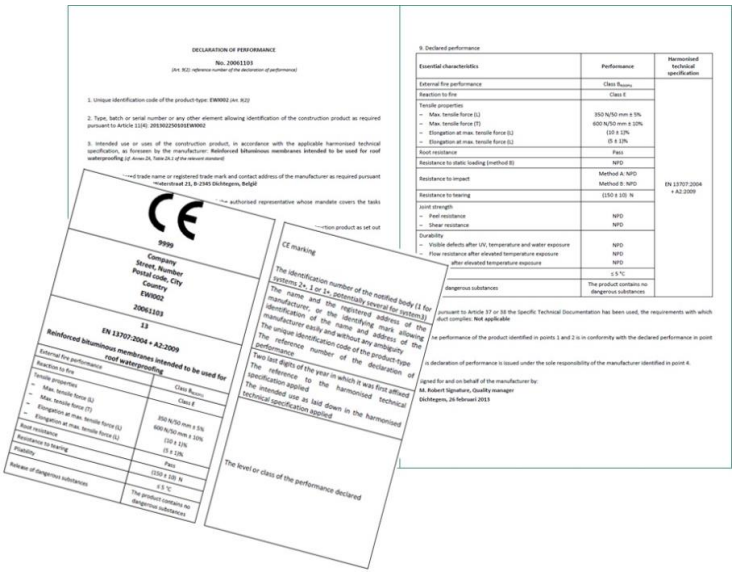
The presence of the CE marking simply means that a declaration of performance is available for the product and that the product to which the CE marking was affixed is in accordance with the performances specified in this declaration of performance. The free marketing of the construction products in the European Economic Area is a result of the availability of product performances, which allow verification with criteria specified in national legislation.

The manner in which manufacturers must determine performances, is specified in harmonised standards, drawn up by the European Committee for Standardisation (CEN, www.cen.eu) and converted into national standards by the national standardisation institutes (e.g. AFNOR in France, BSI in the UK and DIN in Germany) or in European Technical Assessments, issued by one of the members of the European Organisation for Technical Assessments (EOTA, www.eota.eu). Manufacturers may apply for an ETA using any member of EOTA. They should not necessarily make use of the organization of the country from which they originate.

Just as before 1 July 2013 products covered by harmonised standards must bear the CE marking, but since 1 July 2013, they must also be accompanied by the declaration of performance. For products that are not, or not fully covered by harmonised standards, or products for which the evaluation methods laid down in the harmonised standards are not appropriate, manufacturers may apply for a European Technical Assessment (formerly European Technical Approval). Once a European Technical Assessment has been issued for a product, the availability of a declaration of performance and the affixing of the CE marking are obligatory for the manufacturer.

For products that are not covered by a harmonised standard, and for which a European Technical Assessment has not been issued, the availability of a declaration of performance in accordance with Regulation (EU) N° 305/2011 and the affixing of the CE marking is not possible.

Example of a declaration of performance that accompanies the product, the CE marking shall be affixed on the products.


DECLARATION OF PERFORMANCE

No. 20061103

CE

9999

Company
Street, Number
Postal code, City
Country
EW0002

20061103

13

EN 13707:2004 + A2:2009

Reinforced bituminous membranes intended to be used for roof waterproofing

CE marking

The level or class of the performance declared

9. Declared performance

Essential characteristics	Performance	Harmonised technical specification
External fire performance	Class $B_{ROOF(t1)}$	EN 13707:2004 + A2:2009
Reaction to fire	Class E	
Tensile properties		
– Max. tensile force (L)	350 N/50 mm ± 5%	
– Max. tensile force (T)	600 N/50 mm ± 10%	
– Elongation at max. tensile force (L)	(10 ± 12%	
– Elongation at max. tensile force (L)	(5 ± 12%	
Root resistance	Pass	
Resistance to static loading (method B)	NPD	
Resistance to impact	Method A: NPD Method B: NPD	
Resistance to tearing	(150 ± 10) N	
Joint strength		
– Peel resistance	NPD	
– Shear resistance	NPD	
Durability		
– Visible defects after UV, temperature and water exposure	NPD	
– Flow resistance after elevated temperature exposure	NPD	
after elevated temperature exposure	NPD	
	± 5 °C	
dangerous substances	The product contains no dangerous substances	

pursuant to Article 37 or 38 the Specific Technical Documentation has been used; the requirements with which duct complies: Not applicable

he performance of the product identified in points 1 and 2 is in conformity with the declared performance in point

is declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

igned for and on behalf of the manufacturer by:
M. Robert Signature, Quality manager
Dichtegem, 26 februari 2013

It is still intended that manufacturers express the performance of their products in accordance with the provisions of the standard(s) and/or European Technical Assessment and that they can make use of the "No performance determined" option (NPD) for one or more characteristics. This option is especially appropriate when the country of destination does not regulate a characteristic. An essential difference with the situation under Directive 89/106/EEC is that the European Commission

may decide that for one or more characteristics the NPD option may not be applied. Such a decision has not yet been taken.

Common misconception: "**CE marking indicates conformity with a harmonised standard**"
Harmonised standards often include a section relating to the Regulation, comprising the "essential characteristics", i.e. the characteristics that are regulated in at least one member state, and a part that deals with characteristics that are important for the construction industry, but not related to regulations. Harmonised standards specify the essential characteristics of each product covered by the standard and the corresponding evaluation methods (tests or calculations), but rarely provide criteria that products must meet.
In short, as a rule, all products covered by the scope of a harmonised standard are in accordance with the standard. It is therefore important that specifiers of construction products (contractors, architects, designers, home owners, ...) require specific performances, taking into account the specific intended use of the products in their works.

Annex 1 of Regulation (EU) N° 305/2011 sets out the basic requirements for construction works. Just as was the case with Directive 89/106/EEC, Regulation (EU) N° 305/2011 imposes requirements on construction works, not on products. In the context of the Directive, interpretative documents were used by member states to indicate how the requirements for construction works had to be "translated" into the product characteristics. That translation was used to ensure all members states used the same “translation” and determined the characteristics that may be found in harmonised standards and European Technical Assessment. Regulation (EU) N° 305/2011 does not provide for interpretative documents and, pending clarification, it is therefore uncertain whether member states will continue to use the translation agreed upon in the framework of directive 89/106/EEC and how the translation of the new basic requirement for construction works “sustainability of natural resources” into product characteristics will take place.

Common misconception: "**CE marking indicates conformity with Regulation (EU) N° 305/2011"**
Unlike most other European legislation leading to the CE marking of products, Regulation (EU) N° 305/2011 does not specify requirements for construction products. The Regulation sets basic requirements for construction works, i.e. member states’ regulations for works usually fall into one of these basic requirements for construction works. The European Commission mandates the European Committee for Standardisation (CEN) to write so-called harmonised standards comprising the essential characteristics for the products. It is therefore impossible to demonstrate conformity of construction products with the requirements specified in Regulation (EU) N° 305/2011.

In comparison with the situation under Directive 89/106/EEC, the content of the basic requirements for construction works has been changed and one basic requirement has been added. In all probability some of these changes will affect the declaration of performance of some products. Before such changes will be necessary, harmonised standards and European Technical Assessments must be adjusted. It will probably take some time before the basic requirements are adjusted.

A potentially important improvement thanks to Regulation (EU) N° 305/2011 is the creation of Product Contact Points for the construction sector. These organisations should ensure that manufacturers can obtain information regarding the regulations that are in force in the member

states. Also, the responsibilities of economic operators, i.e. manufacturers, distributors and importers, are more clearly presented in comparison with the situation under Directive 89/106/EEC. In some cases, distributors and importers may be held responsible if the manufacturer does not or does not completely work in accordance with the provisions of Regulation (EU) N° 305/2011.

The five attestation of conformity systems that applied in the framework of Directive 89/106/EEC continue to apply under the Regulation and retain their numbering (1+, 1, 2+, 3 and 4). Rather than "attestation of conformity systems", the term now used is "systems for assessment and verification of constancy of performance". The definition of these systems is given in Annex V of the Regulation, which was recently adapted using the Commission Delegated Regulation (EU) N° 568/2014 of 18 February 2014 amending Annex V to Regulation (EU) No 305/2011 of the European Parliament and of the Council as regards the assessment and verification of constancy of performance of construction products. The applicable system(s) for assessment and verification of constancy of performance, which influences the intrinsic level of credibility of the manufacturer's declaration of performance, is determined by the European Commission and the member states. Other stakeholders are not involved in making this decision.

Affixing the CE marking means that the product complies with the performances declared by the manufacturer**. It takes an expert to know whether a third party supported the manufacturer enabling the latter to declare performances in the framework of the Regulation.**

In this example, a number of other signs have been affixed on the product as well. The **ACERMI mark, the** ATG mark, the KOMO mark and the EMPA mark **confirm** the fitness for use of the product by **third parties, taking into account resp. the French, the Belgian, the Dutch and the Swiss environment** and circumstances**. Each of t**he other **quality signs (FM, SGS, Keymark, …)** provide for different messages (conformity with **the complete** European standard**, fire protection performances, …), responding to different needs.**

Although the systems for assessment and verification of constancy of performance often foresee the involvement of a third party, it is the manufacturer who, taking into account the work done by the third party, establishes the declaration of performance and determines the product type. The systems which the manufacturer has to use, take into account the importance of the product with regard to the health and safety of the works and which may vary depending on the product, the intended use of the product and on the essential characteristics for which performances are declared by the manufacturer. It may take an expert to determine the significance of third party involvement.

It is rare that when product certification is required in accordance with Regulation (EU) N° 305/2011, that it applies to all intended uses and essential characteristics. Usually, the product certification only concerns one or a few characteristics, while the manufacturer determines, without the intervention of a third party, the performances for other intended uses and/or for certain characteristics. Whereas this information should be given in the declaration of performance, it requires some knowledge to determine the extent of third party involvement - and thus the reliability of the information contained in this declaration. Unfortunately, in contradiction with the situation prior to 1 July 2013, more than 500 third parties from more than 30 countries, known as notified bodies, cannot rely on the information disseminated by the services of the European Commission in the form of Guidance papers. At this time, it is unclear to what extent these former Guidance papers still apply, whether their use is still being required by notifying authorities and whether these are still being respected by notified bodies and to what extent.

Common misconception: "**By requiring CE marking in works' specifications, specifiers at least ensure that the products will meet all regulatory requirements**"
The CE marking of construction products provides manufacturers with a framework through which they can identify relevant essential characteristics and express product performances. Hence, CE marking ensures a uniform manner of declaring performances with an imposed confidence level.
Individual member states continue to impose criteria deemed necessary taking into account the desired level of security. The manufacturer's declaration of performance may be used for each individual works to assess compliance with those criteria.
Taking into account that CE marking is not an obligation for all construction products, requiring CE marking in works' specifications may result in some products not being able to respond to the requirements even though the products are perfectly fit for the works concerned. It concerns especially products deviating from harmonised standards, i.e. the niche and innovation products. It would be counterproductive to the aims of the internal market if the Regulation led to the construction sector only using traditional products.
Specifiers should establish criteria for the characteristics relevant for the works to be fit for the intended use. Some of the characteristics may be regulated, but it is normal that some of the criteria relate to characteristics or properties that are not regulated (e.g. dimensions, tolerances, shapes, colour, …) and are therefore not part of the information comprised in the declaration of performance and accompanying the CE marking.

The Regulation comprises obligations for manufacturers, distributors and importers. For the other actors in the construction sector, the Regulation does not include any requirements. Contractors who manufacture products and execute, install or incorporate those products into construction works are not obliged to CE mark. However, in case contractors produce factory-made products, CE marking may be technically beneficial and a commercial necessity. As soon as contractors make their products available to other contractors, they place products on the market and become manufacturers according to the Regulation.

From the foregoing it may appear that the benefit of CE marking for construction products is limited. However, Directive 89/106/EEC and Regulation (EU) N° 305/2011 have led to substantial benefits for the construction sector. The most obvious and direct benefit, at least for those trading products in several European Union member states, is the possibility for European manufacturers to trade products without undue technical barriers throughout the European Economic Area, Switzerland and

Turkey (33 Countries). The process towards CE marking has substantially supported the replacement of national by European standards and the creation of new European standards for products not yet covered by national standards, leading to a common technical language that goes far beyond the mere trade of construction products. The best known success story in this regard is that European standardisation also comprises a set of European design codes. Possibly the most significant, but less visible advantage is that many, if not all, European manufacturers work in accordance with a factory production control system, i.e. systems according to EN ISO 9001, but focus on technical aspects.