On the innovative forms of communication in forensic engineering: the italian contest

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Abstract

In the Forensic Engineering, the Engineer figure (as both Court-Appointed Engineer and Party-Appointed Expert) is appointed to assume the role of "scientific" figure, which is necessary in order to solve of particular and complex technical problems.
In this paper, we intend to develop and to out-line a particular aspect of the procedure: the typical path in documental practice through the comparison with the legislation, focusing on documents production and validation, also paying attention on digital formats allowed by the Code.
The innovative Italian Contest will be analyzed for his current change process.
The Italian Laws, according to the innovative telematics civil procedure (the so-called PCT Process Civil Telematics), permits to deposit a limited number of document formats; this represents a real limit to understanding the facts. Besides, this documental limit is not present in penal procedure.
In this paper how to integrate new formats will be discussed by means of a real case example. In the complex legal-technical world in which we have to operate, extremely specialized figures coexist with generally different knowledge substrate (Socio-Humanistic Sciences for Lawyers and Court, Physical-Mathematical Sciences for Engineers and Technical Experts).
So different methodologies and languages, i.e., different Cultures, have to interface; this could be relevant and meaningful if a Cultural Heritage structure is considered in the Forensic Process.
A proposal for digital integration is therefore necessary, as auxiliary and innovative supporting effort, in order to develop a clearer and more efficient communication standard.
The recent Process Reform (the so-called Cartabia Reform) tends to an innovative goal: to mix new technological know-how; so, actions, events, moving images, sounds, numerical results have to be correctly presented and understood, above all if an existing structure, probably having a Cultural Heritage value, is under consideration.
This paper focuses on the burden of proof and introduces an overview of key legal concepts, the system of governance and the general law-making process.

Keywords

Communication paradigm, Digital format, Judicial Acts telematics deposit, Representation parameters

1. Introduction

The paper aims to be the first in order to underline the importance of the new techniques for representing Built Heritage in the case of Forensic Engineering approach: in particular, various temporal phases concerning Built Heritage survey have to be considered.
We will not mention the various techniques of Cultural Heritage representation but we propose a practical research approach rarely present in the literature, focusing on the "work file" as an object of evidence produced to be used in the legal field.

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We will analyze its potential in the context of Forensic Engineering linked to the preservation of the Built Heritage and we will discuss the effective integration of Italian legislation into ICT change.

Until 2014, the objectives of European Union for digital transition have been carried out by the Italian Justice Ministry through an articulated network of projects according to national former laws: the so-called Bassanini law (1997), the 445/2000 Decree of the President of the Republic and the 82/2005 Legislative Decree aiming the "Digital Administration".

According to European Union [1]: "… digital technology and infrastructure have a critical role in our private lives and business environments. We rely on them to communicate, work, advance science and answer current environmental problems …".

In this general perspective, the Digital Europe programme was stated too by the Regulation (EU) 2021/694 of the European Parliament and of the Council of 29 April 2021 that establishes the Digital Europe Programme and repealing Decision (EU) 2015/2240, [1].

In the current context of the so-called Industry 4.0 (an general Italian Government economical measure), the digital strategy of the Ministry of Justice has to be placed within the complex programmatic and regulatory framework of European Union.

Through the delegated Laws for Civil Process Reform (Law No. 206/2021, published in 2021/12/09 Italian Official Gazette) and of the Penal Process Reform (Law No. 134/2021, published in 2021/10/04 Italian Official Gazette), a transition phase is now in act.

This transition fraught with consequences for professional figures, particularly for Engineers: this is a very challenging occasion for Professional Figures to participate to a legislative changing phase, above all if that phase regards to safeguard the fundamental rights and the interests of Professional Categories.

The growing awareness of the centrality of judicial datum has to be considered, as everyone's a worthy of attention.

Each judicial datum has to be deposited and to be collected in a mega-data system. In this form, the single judicial datum can assume both the sense of citizen freedom guarantee and the consequence of citizen freedom infringement.

Innovative and technological procedures, in judicial activity, to acquire a relevant fact (as a digital interrogation) and processes it can cause negative effects.

In a different perspective, the regulated availability of the data and its appropriate conservation and dissemination constitute tools for the effective implementation of the real citizen equality of citizens in respect of Court power. It allows overcoming information asymmetries, which limit citizen ability to interact effectively with the Authority, both in a judicial process and in an economic and social contest.

The declared objective of the Reform, the judicial digitization as its goal, is the production of new and broader forms of knowledge, aiming to provide new fundamental requisites for an increasingly aware exercise of the Jurisdiction.

The Reform isn't a simple and a mere dematerialization of acts and documents but assumes the role of to widen the scope of opportunities.

Based on these principles, this paper aims to contextualize the request for new forms of proof for the exercise of the profession of engineer within the courts, not only as expert or consultant, but as an effective part of Ministry of Justice system.

In particular, it must be emphasized that for a Forensic Structural Engineer specifically, the field of action concerns the Built Heritage.

In particular, a Built structure has normally a great background of observations, drawings, pictures, reports and so on; this background has to be correctly considered in an actual representation and analysis activity as current in a Forensic evaluation.

The results of the actual evaluation can be forced by the data collected, by different authors, during former structure life.

The forms of representation of this, such as Visual Pattern Extraction and Recognition, are fundamental for the preservation of the Heritage itself and those who inhabit it.

In this paper, according to Authors experience, two case study examples of different Visual Pattern Extraction and Recognition are presented.

The first case is the finite element modelling of failure mechanism in the abutment of a small collapsed bridge; the second case is the drone photogrammetry survey of an ancient small town involved in the L'Aquila 2009 Earthquake.

Both cases are actual representative approaches, both cases can be usefulness in order to open a discussion regarding new formats of Legal evidence.

Knowledge is therefore not the only purpose to ask for the right space within the regulations and the integration of new formats aimed at producing legal evidence.

Knowledge is correctly to understand any past information at disposal.

Obviously, in the background and as unsolvable matter for the moment, the theme of the effective possibility of understanding the different levels of Knowledge and Culture remains: the Legal and the Engineering one.

The paper is organized as follows: a first part of regulatory contextualization, briefly describing the current legal-administrative innovations and the modus operandi of the electronic submission of documentary procedures.

A second part offers an overview of the Authors' proposals for innovation, concretizing them in two different case studies, one of which regarding Forensic Structural Engineering of a penal nature.

A third part explains the importance and delicacy of integrating these proposals into the context, touching aspects of communication forms as well as engineering and legal ones.

Finally, the conclusions report the Authors' personal considerations and the scientific-operational proposal.

2. Civil and Penal Litigation

It is well known, [2] that the nature of the Italian Civil justice system is neither purely contradictory nor purely inquisitorial.

It should be emphasized, however, that the most significant power to ask questions, set up defenses and above all to present evidence is together with the rights almost mainly of the parties in the case, since it is good to remember that in civil the judge plays a more passive role than in criminal litigation.

The burden of proof is the principle on which civil liability is based.

In Civil Legislation, the evidence to be presented to the Court is headed by the Parties in terms of collection and storage, as according to the relevant principle of the burden of proof.

However, it is important to underline that the Court has considerable investigative powers of its own motion to meet the needs of the case; in particular, it has a general power to order expert opinions, to request information from public authorities and to request clarification from witnesses.

Italian criminal law is primarily a contradictory system.

The most significant rights and powers are attributed to the Process Parties, the Prosecutor on the one hand and a Defense Lawyer on the other.

Parties are responsible for providing evidence of the guilt or innocence of an accused.

However, it is frequent in forensic engineering cases, to reach a decision; the judge can present further evidence at the trial.

The Parties are responsible for gathering and filing evidence with the Court.

The Court may request a more in-depth technical examination by the Parties on a specific issue or suggest a new investigation.

3. Telematics Process Basis and Code Framework

The first regulatory act that gave the real impetus to the Telematics Process is Article 4 of the Legislative Decree 29 December 2009, No. 193 (actually Law February 22, 2010, No. 24 entitled "Urgent interventions regarding the functionality of the Judicial System"). It started a lot of activities regarding telematics process improvement, [3].

This provision attributes to the Ministry of Justice, in conjunction with the Ministry for Public Administration and Innovation, the regulatory power to identify new technical rules for the information adoption and communication technologies in civil and penal processes.

Based on the aforementioned Article 4 of the Legislative Decree 29 December 2009, No. 193, the Ministry Decree No. 44/2011 was enacted: it governs the basis of the Telematics Process and it is supplemented by Ministry Decree No. 209/2012 and by Ministry Decree No. 48/2013.

Finally, both Legislative Decree 90/2014 and Legislative Decree 132/2014 completed the regulation and definitively set starting dates for the Telematics Civil Process.

In this manner, actual Code governs both every process degree and its executive procedures; this framework is the above mentioned Italian contest and it is the subject-matter of this paper.

4. Electronic submission of procedural documents

With the introduction of the Civil Telematics Process (PTC Italian acronym), the methods for drafting telematics measures have also changed, at least starting from 2014/06/30.

With the advent of the Civil Telematics Process, the submission of all types of documents has to take place almost exclusively and necessarily by telematics manner: this procedure is extremely rigid and the authenticated users, only, can use their login credentials to access the services portal of the Ministry of Justice, [9], [10], [11], in order to deposit any content.

In particular, the user access is forbidden at the end of the procedure too. In this manner, data collection and database formation is very rigid.

However, the Article 44 of the Legislative Decree No. 90/2014 refers, for judgments other than the admonitory one, considering an act occurring during the course of the proceedings (the so-called internal document), prescribes to respect the format of electronic documents shown in Fig. 1, with regard to both the mandatory and facultative electronic submission.

The internal documents submission must therefore take place exclusively by electronic transmission, using the services portal of the Ministry of Justice.

For this regulation, the official technical consultancy documents, which are part of ordinary litigation, fall into this category of internal documents too.

From the formats specified in the regulation, it is clear that it is impossible to deposit files other than text and images, since the technical specifications do not include video and audio extensions: in practice, a digitization has been imagined but in the context of an approach "typewriter" or as a part of a typical "amanuensis art" altogether.

The relevant issue is to permit both a document general kind submission and electronic size control.

One of the solutions used is to compress the content, audio or video files, in one of the formats allowed by the Technical Specifications of PCT procedure, i.e. the extensions .rar, .zip, .arj.

Surprisingly it should be emphasized that the same Article 13 of the Technical Specifications, in allowing the use of compressed files, provides that within these, only the files indicated in Paragraph 1 can be considered: so files with audio and video extensions have to be avoided!!!!!.

The second technically possible solution consists in attaching the audio or video file to the .pdf document by means of a specific link. In this manner, the unauthorized files can be used through the .pdf "box", in which they are contained.

It should be emphasized that this trick presents a certain difficulty, since the recipient must always have compatible software (e.g., Adobe Flash Player) in order to open the .pdf file and access the content.

Although it may appear paradoxical, in an epoch invaded by computerization it is unfortunately normal that the Judge and the other Parties are unable to access the multimedia content.

It could be a very troublesome misunderstanding at the debate moment; the Engineer could be persuaded to have made himself clear and then he could experience a communicative failure: the Court did not realize the sense of his expertise merely for a consultation problem.

For this reason, a Court of Rome with 2015/01/24 sentence decided that DGSIA (acronym of General Department of Automatic Information Systems - Ministry of Justice), is deprived of power to identify number and characteristics of deeds that may be deposited.

Therefore, submission of deeds and measures not expressly contemplated in the authorizing decree must be considered admissible according to the general principle contained in Article 121 of Code of Civil Procedure that states: "… for which the acts of the process, for which the law does not require specific forms, can be performed in the most suitable form, to achieve their purpose …".

FORMAT OF ELECTRONIC DOCUMENTS
TECHNICAL SPECIFICATIONS DM 44/2011 ITA
ART.13 (Format of attached electronic documents – art. 12 Regulation)

1. The attached documents have no active elements, including Macros and Variable Fields. And only the following formats are allowed:

a) .pdf **b) .rtf** **c) .txt**

d) .jpg **e) .gif** **f) . tiff** **g) .xml**

h) .eml
Provided they contain files in the formats referred to in the previous letters

i) .msg
Provided they contain files in the formats specified in letters a to h

2. The use of the following compressed formats is allowed because they contain files in the formats indicated in the previous paragraph:

a) .zip **b) .rar** **c) .arj**

3. Attachments can be signed with digital signature or qualified electronic signature; in the case of compressed formats the digital signature, if present, must be applied after compression.

Figure 1: Format of electronic documents that can be attached according to current Italian Legislation in the Civil Process procedure.

It could be appeared that the appropriate methodology to guarantee the acquisition and knowledge of the proposed audio and video investigative means remains the deposit in the registry through media such as CDs, DVDs and USB memories.

However, this is strictly forbidden by the PCT procedure.

This is, in Authors opinion, an evident discrepancy among Civil Process and among Penal Process.

The sense of provisions included in the Cartabia Reform aim to achieve the digital transition of the penal process, through innovations in terms of preparation, submission, notification and communication of documents, [12], [14], [15].

In addition it introduces, what's more some innovations in the field of audio-visual recordings too.

Due to remote participation increase in some proceedings or hearings, due to pandemic situation, it underlines the importance of audio and video files in relations with Court demand.

This has to be extended to Civil process: there will no longer be editorial dimensional limits of technical documents, there will no longer be file format limits of consultant documents.

Obviously, this has not an absolute sense: a mandatory limit has to be preserved for data base dimension for each Part of the process (not a limit for each document as today) while regarding to file format a principles of good sense has to be considered.

If an Engineer has to deposit a document edited in a unconventional operating system, he has to be sure of his failure.

5. Proposal for Innovation in Communication Types

As above discussed and as discussed during its adoption by Parliament, Cartabia Reform has the ambition to carry out a real organic review of the process combined with models of complementary justice, to ensure the enhancement of principles of simplicity, conciseness, data protection effectiveness and, above all, process reasonable duration. Furthermore, reference is made to the requirements that a document must comply with authenticity, integrity, legibility, traceability, interoperability envisaged by the eIDAS regulation (electronic IDentification Authentication and Signature - 2014/910 Guidelines).

On the basis of this renewal idea of the system; on the basis of an intervention on the relationship between ordinary jurisdiction and the forms of alternative and complementary justice; on the basis of to enhance the institutions of mediation and assisted negotiation, it is worth noting the importance of using audio and more videos for a more exhaustive presentation of the facts.

Let us to discuss this in engineering field using two different case studies in Forensic Engineering: the first is the finite element modelling of failure mechanism in the abutment of a small collapsed bridge, this modelling was requested to the Authors in a Judicial process.

As well known and as for engineering current language, the description of the laws of physics for space-dependent and time-dependent problems are usually expressed in terms of partial differential equations (PDEs); for the vast majority of geometries and problems, these PDEs cannot be solved with analytical methods.

Instead, an approximation of the equations can be constructed, typically based upon different types of discretization.

These discretization methods approximate the PDEs with numerical model equations, which can be solved using numerical methods.

The solution to the numerical model equations are, in turn, an approximation of the real solution to the PDEs.

The finite element method (FEM) is used to compute such approximations.

A lot of numerical codes, a lot of software house and many researchers are involved in this activity around the world.

Could appear very simple that, in the absence of video recording of an event in real time, it is possible to reconstruct the various components in a virtual environment.

The Engineer therefore has the possibility, as well as the fundamental task, of modelling the mechanism and the physics itself that he intends to reproduce within the FEM environment, correctly placing constraints, ground connections and connections between components, external effects such as forces and temperatures, and finally choosing the right dimensions for the simulation geometry and time step.

One of the most important aspects to underline is that in FEM analysis, space and time are not continuous concepts, but become successions of points, which in any case succeed in the extraordinary feat of recreating events by circumscribing them in well-defined time horizons. Both elements, space and time, depend on numerical discretization and depend on engineer basic choice.

It appears that the FEM modelling, in addition to offering the tools for the linear and non-linear analysis of the stress in numerical values decipherable only from the inside, through the reproduction of a video that shows the phases in a continuous way, gives the possibility to communicate clearly and exhaustive the trend of particular conditions over time.

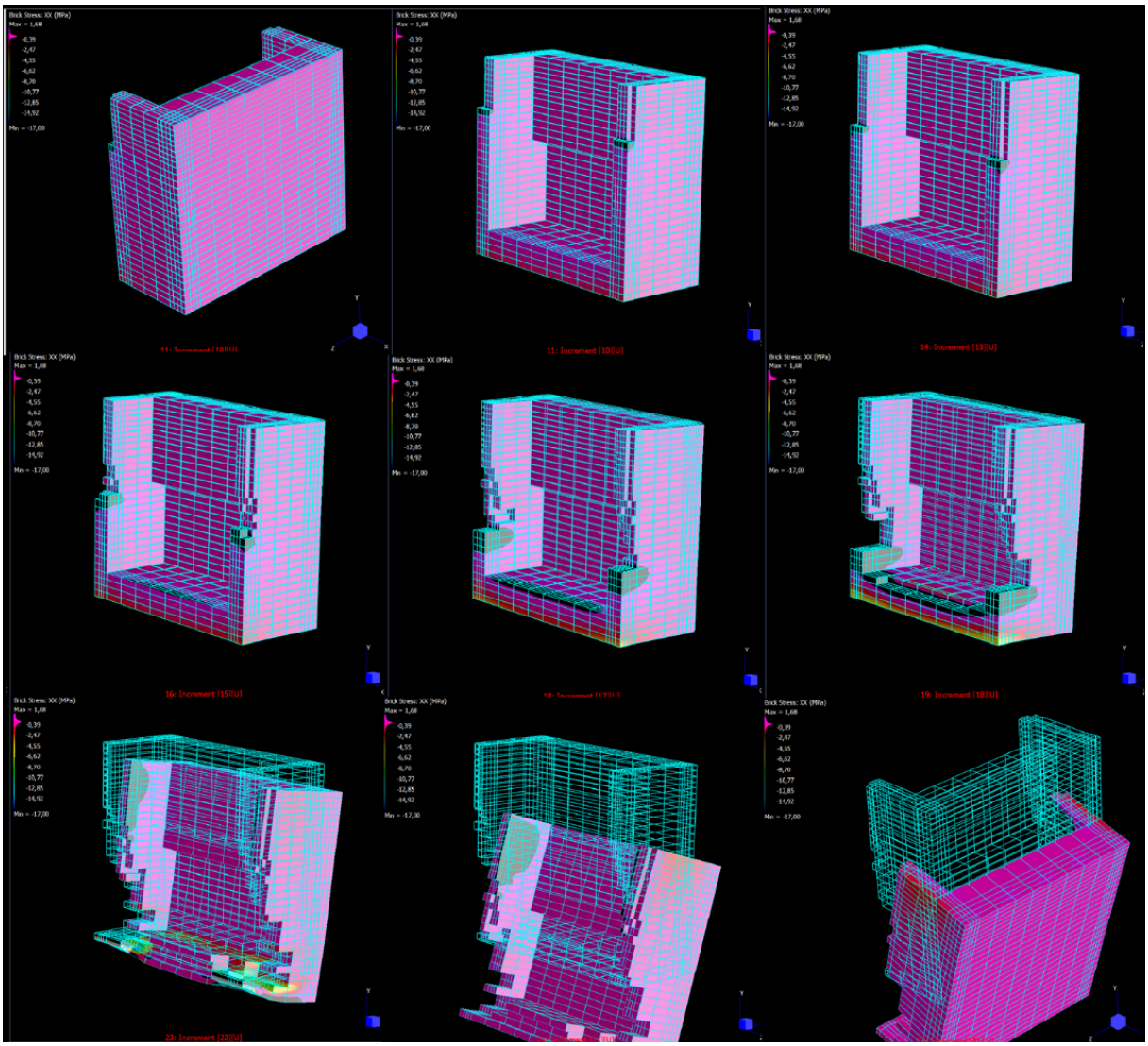

Figure 2: Images of video clips of a FEM modelling of a collapse of a structural part of a bridge

Based on these conditions, clearly well-known for an Engineer, for which theme like kinematics and dynamics are, or should be, absolutely clear the standard representation with a model, and a graphical representation, of the FEM type it allows the understanding of the topics even for subjects not having the basic knowledge of the Engineer.

This representation, for which the Engineer assumes responsibility, defining the modelling conditions (geometry, shape functions, constitutive links, constraint conditions, boundary conditions, etc.), becomes formally usable to a wider audience and can become a necessary condition for the issue of a weighted and, above all, balanced judgment.

In many conditions it is not always possible to establish a certain and univocal path: let us imagine, for example, the analysis of a phenomenon whose initial conditions are not

experimentally known, how can the Judge, or the Judgment, make a decision which leads to the reconstitution of these initial conditions?

In such a case, only the simulated variations of these initial conditions with the development of the process can lead to such a judgment in a considered way: but this development must be presented in a way that is understandable for a wider audience different that of the Forensic Engineer.

This topic will be developed in a parallel paper: here it should not be overlooked that the basic hypotheses of FEM modelling are extremely delicate and extremely difficult for the non-expert, the Judge, to evaluate.

Then the contradiction between the different figures becomes essential.

On this proposal, it just think of time significance: in FEM model, the time is a discretization parameter, the time represents the sequence of numerical analysis and the sequence of discretization methods that approximate the PDEs with numerical model equations, which can be solved using numerical methods.

If a FEM video is presented to a Court, if the Engineer is not able to underline this aspect, it could be possible that time (numerical) approximation can be assumed by the Court as an absolute value, it could be possible for the Court to make faulty conclusions and it could possible for Justice to fail.

This failure can be considered as unexpected but it has to be considered if no special attention is no paid to an appropriate visual presentation of data, [13].

The second case study is the drone photogrammetry survey of an ancient small town involved in the L'Aquila 2009 Earthquake; this survey was carried out by the Authors in the urban rebuilding process in the aftermath of a destructive earthquake.

Among the initial phases that concern a project we have the architectural survey, an operation which is necessary to define the initial conditions (both in a process and in a design planning).

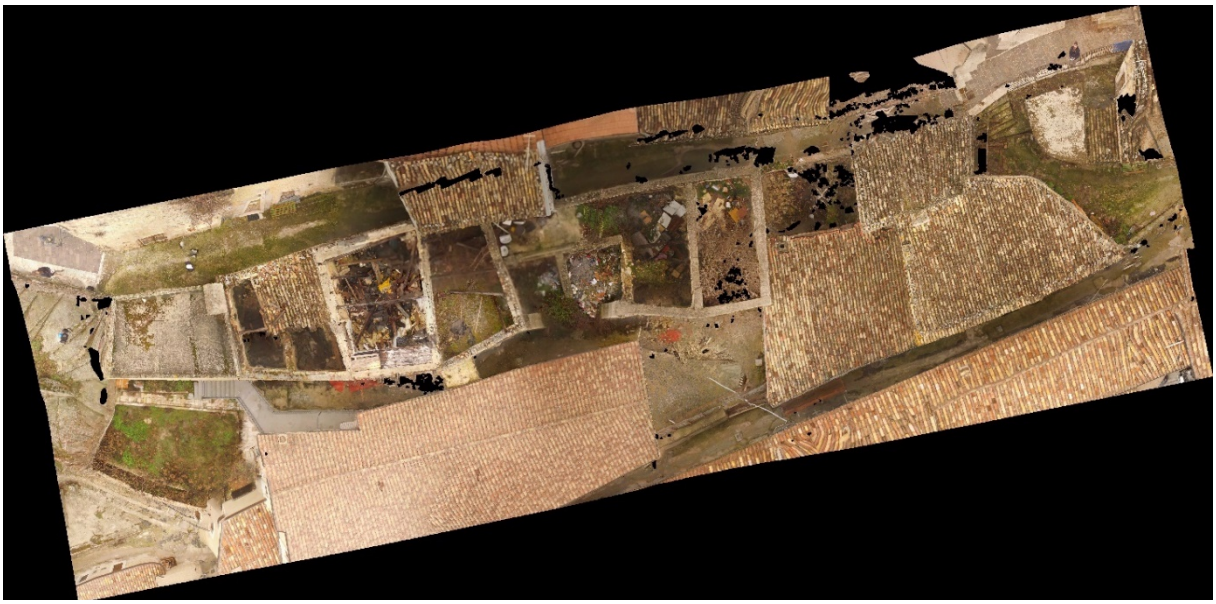

Figure 3: Zenithal view of the 3D point cloud survey, carried out using a drone in a ancient small town involved in the L'Aquila 2009 Earthquake

Having a structured documentation, including exact and irrefutable data – essential to reconstruct the initial conditions – allows a clearer understanding, which is crucial to become aware of the circumstances and make correct choices in order to express a judgment in case of a trial.

However, in Forensic Structural Engineering, it's not always possible to reconstruct or have information related to the initial situation – for example, to have a clear overview of a structure

before a collapse occurred – but it's easy to provide a visual overview of a post-collapse situation, as shown in the Fig. 3.

The proposed zenithal view of the 3D point cloud survey is very clear and it appears as very intellegible for a global audience.

So any person can image to have clear a complex scenario that otherwise it is not really entirely clear.

In fact, as in other Forensic situations such as Forensic medicine, only the Engineer experience permits to obtain correct information starting from an apparently simple reality reproduction.

Only the Engineer experience permits to use correct event and context reconstruction techniques, only the Engineer effort permits to use and to exchange of new and innovative forms of communication in Forensic Structural Engineering.

6. The Communication Paradigm

Finally, the Authors try to contextualize this audio/video form of proposing documents within a transposition used in the literature to define the general scheme of communication processes.

The communication model theorized by Claude Shannon and Warren Weaver, created in 1948 and published in the article "The mathematical theory of communication" was referred to as the "mother of all models", as shown in Fig. 4.

The objective of the model conceived by Shannon-Weaver was to develop a theory that would make communication systems more efficient, starting from the structure of the essential elements from which it is formed: source, receiver, message, channel, coding and decoding, including the concept of "noise", understood as "… the interference that obscures the perception of the message …".

It is not trivial to assume that it can be considered as "noise" the normal audience unpreparedness too.

As well known, the model was integrated with various contributions later, the one shown in the previous diagram is by Wilbur Schramm.

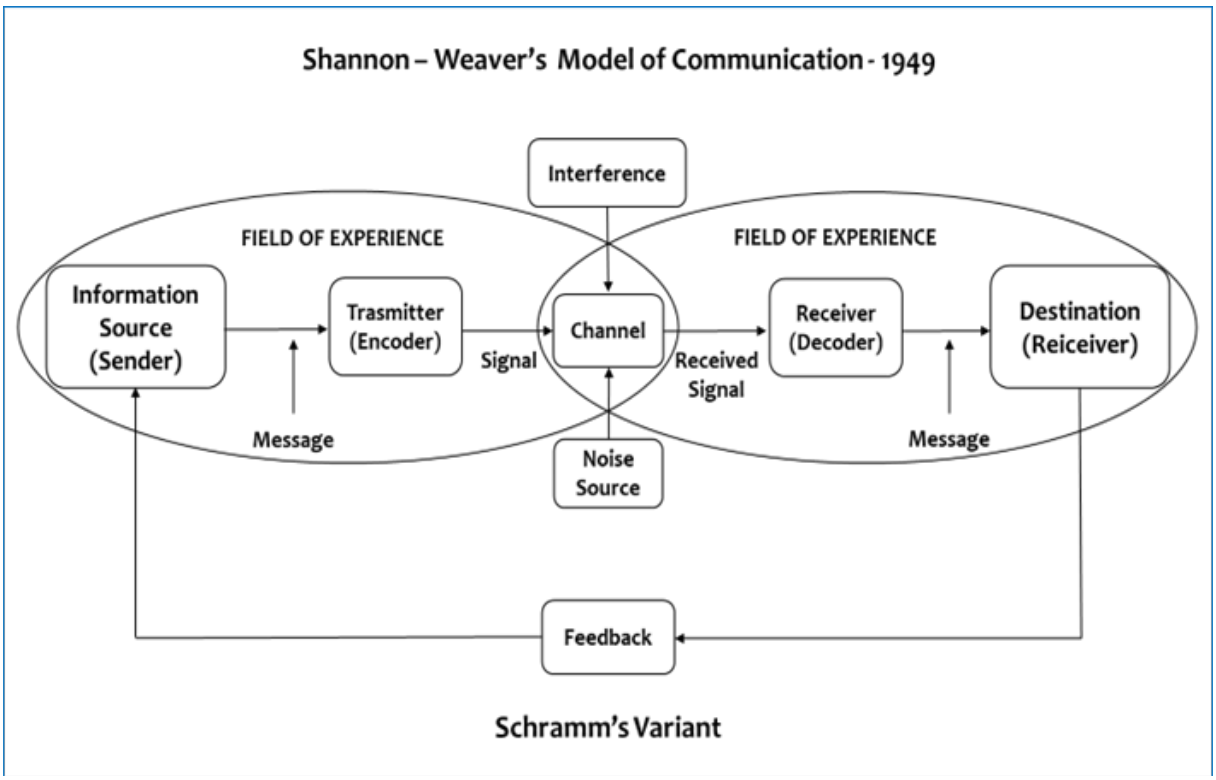

Figure 4: Shannon–Weaver Communication Model with Variant of Schramm

According to Schramm proposal, the closure and one-sidedness of the scheme is transformed into a continuum, made up of coding, decoding and interpretation but above all, it introduces feedback by creating a path similar to the communicative one but in the opposite direction.

The Engineer can be identified with the figure of the Sender, who has the need (given by the task assigned to him) to transmit a message to the Receiver (Legal and Juridical Actors), the Message is (video or audio) the virtual reproduction of a real event, [7].

Generally, in a verbal communication, the Channel is characterized by natural sound and human capacity; but in our case, being the message a video or an audio, it will be the digital tools.

In a companion paper [4], we will focus on the Encoding of the Message and the hypotheses at its basis and their crucial importance.

In fact, in order to send the Message, which can be interpreted and understood by the Receiver, the Engineer must succeed with many difficulties in using a Numerical Code (understood as linguistic but cultural and/or symbolic) that is clear and whose basic hypotheses are intelligible and the limits.

If the Sender acquires this awareness and ability, he will have greater awareness in understanding the decoding mechanisms of the subjects to whom he will have to address.

Finally, the Decoding of the Code is the process that allows the Receiver to interpret correctly the Sender's message; however, this operation is also far from trivial in the communication between Engineers with Judges, Lawyers and other Parts of the process.

To make the transmission of information as well as the decoding even more difficult we find the Noise which in this context is valid both in the physical sense (the background noise in an environment) and in the broad sense (the thoughts that fluctuate in the head of the recipient).

Above all the noise is the complexity of the theoretical hypotheses that the Sender (Engineer) has made and that the Receiver (Judge) is not always able to check, [4], [6], [8].

7. Conclusions

In a society, like Italian contest, with a markedly humanistic culture, we mainly are forced to entrust the presentation of the results of an activity that has scientific relevance and content to the ability to speak.

We often simply add the written word to the spoken word, disregarding, by the Sender, any efficiency in knowledge, by the Receiver.

For this reason, in this paper it is proposed to use within the current Code background, forms of reproduction and simulation of events, which could allow us to provide new evidence of a different nature, facilitating the achievement of the underlying truth.

That has to govern the final judgment and to characterize its out coming.

All this by invoking the principles of freedom of forms, conciseness and clarity formulated by the Article 121 of actual Italian Code of Civil Procedure regarding of the processual documents.

The paper discusses this topic both in legislative point of view and in practical point of view; two different case studies are presented in order to underline the difficulty for a correct usage of innovative Forms of Communication in Forensic Engineering.

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