

REVERSIBILITY FOR SUSTAINABILITY IN EMERGENCY INTERVENTIONS

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Abstract

The general objective is finding the ways to define a design for an emergency housing form, temporary and reversible, able to create positive trends of comebacks and recycle, in the range of the opportunities proposed by the marketplace. This aim needs:

- Collect and analyse of the referred experiences, due to their features (target of use, features of production, matters, building technologies), to the range of temporariness, and search for the main features of temporary architecture, from the formal, technical and logistic points of view.
- The extrapolation and systematisation of the features referred to temporary and reversible intervention, through the definition of a demand framework; processing the hypothesis about a process scale model for emergency temporary intervention; processing the hypothesis about a process scale model for intervention project.
- The definition of the instruments supporting designing decisions.

Keywords: Temporary; Sustainable; Process

INTRODUCTION

This paper is the result of the activities developed within the PHD¹ thesis in Architecture Technologies, at the Faculty of Architecture of Reggio Calabria, as well as other studies conducted within the TEMENOS² research group.

The general objective of the research is the analysis of the concept of "reversibility" in the building sector, and its applicability to the contemporary constructive activity in terms of project quality and environmental sustainability. Such objective is pursuable by a management that is aware about the resources in the building sector, bringing back to the concept that all the resources are productive factors, both the new ones, and the others coming from cycles in use. In particular, this research is finalized to point the criteria about the planning of a "transitory" building system, characterized by its reversibility in every process phase, both at the product level, both at the project one. The specific objective of this work is the elaboration of a system of tools to manage the "temporary" intervention, in which with the term "management" is

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intended as the definition of Guide Lines for planning a transitory and reversing housing form; among several typologies of use of the housing forms, there is the emergency shelter for the short and medium period (3 months - 1 year). A system of Guide Lines created to manage the features referred to the process matters (locking and rationalization of the resources, means of transporting and production, contextualization, etc.) and also the specific features connected to the project of the architectural object (formal choices and techniques).

THE TEMPORARINESS IN THE BUILDING SECTOR: PROVISIONAL OR REVERSIBLE?

The changes in the building sector require a revision of the factors defining the productive process of the built object, and the first priorities to reach the final achievement.

The variable factors are becoming the guide to the choice for the project solutions introducing the concept of temporariness, known not as “time for doing”, but as “time for using”; in fact, the “transitory” adjective, as that “temporary”, is able to be used in both situations, in which the physical consistence of the architectural object, or its conditions of use, is the one being limited in time (variability of the destination of use and utility). In the first case, the architectural research has made its own the managerial aspect of the “maintenance”, by the introduction and development of a tool as the “plan of maintenance”, and the analysis about the performance of the materials. In the second case, the problem has been dealt through provisional structures, whose realization, just like all the connected activities before and after the construction, is characterized by the attribute of precariousness (stands, awnings, containers, etc.). Such approach, in some cases, has produced situations of dissatisfaction about the level of fruition and the comfort of the spaces (systems for housing use) and unbalances as regards environmental and productive thematic, due to the choice of materials and techniques, used to face the ephemeral character of the architectural object, which has ended up having preference for economic convenience and quickness features, losing a rational and more environmentally conscious use of the resources. This negative mean of the ephemeral character of some buildings is a relatively recent acquisition of the western culture; we can find some impressive examples travelling in space and time: they all have in common the same concern for the dismantling phase of the architectural object, and so they show the common need to “Go Back”. A need linked to the concept of time, with the original definition of the term Reversibility: “(...) *etymologically with reversibility, shows the capability to go back to the starting point. But this definition is not sufficient (...) for a correct scientific meaning of the term, (...) adding that it has to be specified that to have a full awareness of the phenomenon the knowledge about how to go back is needed*”³, and that moves the attention from the object to the corresponding process.

The definition of a reversible process for the realization of every kind of architecture, and in particular, for the residential buildings, that shifts from the concept of adaptability of the systems (where the mentioned systems have to be intended as the organism with all its components, and the lower systems including components and implants), needs a revision of the structural requirements and conventional

rules, according to the logic introduced by the *transitoriness*. This new way in reading the structural requirements, has to avoid the risk of a simplification of the matters about architectural project, that otherwise would compromise the habitability of the settlements planned. An exemplification about this kind of risk is provided, in its extreme consequences, by the emergency housing modules which, referring to the excessive simplification of the functional needs, and the corresponding levels of performance, shown their inadequacy in the medium-long term period.

HYPOTHESIS PLANNING

Planning in terms of reversibility and, in particular, in the emergency shelter sector, is taking act of the reduced duration time of the architectural object, when the time limit doesn't coincide with the deterioration of its parts, but with the lack of applications, and so of its destination use. The actual situation in the field of the temporary architecture sees a use of "closed systems", undiversified as regards the typology of the request, that usually needs complex and expensive interventions of re-adaptability, prejudicing its re-use. The analysis of the temporary system markets has made obvious some visible problems, as:

- Invariability of the structural requirements;
- Reduced performance in terms of environmental quality;
- Elevated management costs for the process, (matters in supplying, need of storage areas, paralysis of the productive factors for a long term);
- Reduced levels of structural requirement maintenance;
- User dissatisfactions.

The suitable answer for the above - said queries has to necessarily be an answer in which the system has to be the result of the correct function of the process accomplishment. For this reason a project hypothesis for a transitory and reversible housing module, is transversal to the research path, because it was elaborated in order to respond to the implemented structural requirements and, at the same time, not concluded in itself, since, it is just to say implemented, through the application of elaborated management tools (CoDec, CoAd).

In consideration of this, the project of the architectural object consists of two systems, an "invariant" one, since it constitutes the structural and fundamental system of the housing module, provided depending on the scheme of the assembling kit, and an "variant" one, since it includes all the component parts of completion and implementation of object's performance. The project choice of distinguishing a part, let's say structural, from an envelopment that gives answers to the needs requested in precedence, also giving the possibility to take advantage from the intrinsic characteristics of reversibility in the available production, without the necessity to carry out complex phenomenon of re-conversion in the actual production. The structural system, in fact, is the first equipment of the architectural object, and it is composed of iron structural elements (the choice of this material responds both to structural and economical demands), that is already available in the productive sector, punched and ready to be assembled in the building location by a "dry assembly technique". The "variable system", instead, is established by the production of covering systems, with simple and compound panels completing the

housing system equipment. The distribution space and the structural project of the invariant system is based on a modular measurement of 1, 20m, in accordance with the dimensions of the generally available components in the marketplace. Moreover, the capability to assemble the above mentioned component, without distinction, as regards vertical and horizontal, makes it possible to use panels measuring 1m. The features connected to dimension, module typology and its referring systems, to the orographic area, as well as the system installation plants, are all necessary factors composing the definition of the mentioned housing system. But, because of the complexity of the variable factors and their own variability, depending on the kind of emergency and regarding users and available resources, they also require the elaboration of a managing and checking tool, including the entire building process through different levels of differentiated information.

COGEST-CODEC-COAD CODES' APPLICATION SPHERE

The reading and the analysis of the relative data connected to an extremely complex situation, nailed by the hypothesis of the process model, require the definition of tools referred to information management (codes), calibrated according to the objectives of every phase of the process (fig.1). The information about the construction of the process model is characterized by differentiated analysis levels, functional to the defined objectives:

- The individualization of the characteristics data and their transmission to the "actors" of the process;
- The knowledge about the peculiar characteristics of the context;
- The rational management of input and output flows;
- The correspondence between the performance of the individualized solutions and the requirements expressed by users.

The verification of the tools proposed for the management of a transitory and reversible intervention in case of emergency⁴, consists of the application of an elaborated documentation taken from a current research, performed through the simulation of an event, including the different typologies of the emergency. For this purpose, it is necessary to build a reference "scenery", representing the virtual context of the proper actions of intervention. The construction of such scenery needs a collection of some categories of information, able to point in an univocal way the features of the matter, to inform the project.

Indications for the project: retrieval and classification of the information

The preliminary realization phase of the process compares the matters referred to the planning of the activities, by the elaboration of the main information. The retrieved and organized data constitutes the "Scenery" of the context (retrieval and classification of the information), or the gathering of the useful data to elaborate an economic, social and physical picture of the interested area referred to the settlement, through the application of characteristic features in the pointed informative areas, through the application of the Management Code:

- Typology of transitoriness⁵: individualization of the typology of transitoriness, and description of the characteristics of the event.
- Matters (of intervention): definition of the time interval of the intervention.
- Organization of the connections (transports).
- Organization of the urban plan.
- Productive sector.

The information obtained in this way are the base of the "Scenery" of intervention (translation of the information), or of the elaboration of the project model for a transitory and reversing emergency housing system, through the extrapolation of the:

- Further necessary requirements/ the summary of requirements for the intervention.

Guide to the decisions of project. 1^a contextualization: elaboration of the information

The following phase uses the information extracted in the preceding one to reach concerning decisions about the project, in fact, through the application of the Code of Decision it is possible to reach to the individualization:

- of the application field as it regards the characteristics of use and the context of reference. It provides indications related to the number and to the constitution of nucleuses of user (singles, families, elderly, bearers of handicap, etc.).
- of the characteristics regarding the location of the settlement, related to the typology of the "ground attack system"; to the dimension and typology of the housing modules; to the organization for the planning settlements.

Adaptability of the project. 2^a contextualization (elaboration of the information)

This phase of the process is the more inherent the formal and technological definition of the architectural object and it has the purpose to guide the project towards choices of plans, that are able to assure a suitable level of performance in comparison to the environmental context (climate), in which the housing system is inserted. It is also the phase in which the requirement of reversibility expounds its function of rationalization of the productive factors, because it provides the "discriminant" for the choice of the components of implementation for the project.

(THE) INTERVENTION MANAGING CODE

The analysis of the experiences done in the latest years about the management of the transitory interventions, particularly referred to the matters about emergency in national and international contexts, shown the determinant features but also the limits of the more widespread approaches, as well as it gave the functional data to create a reference frame.

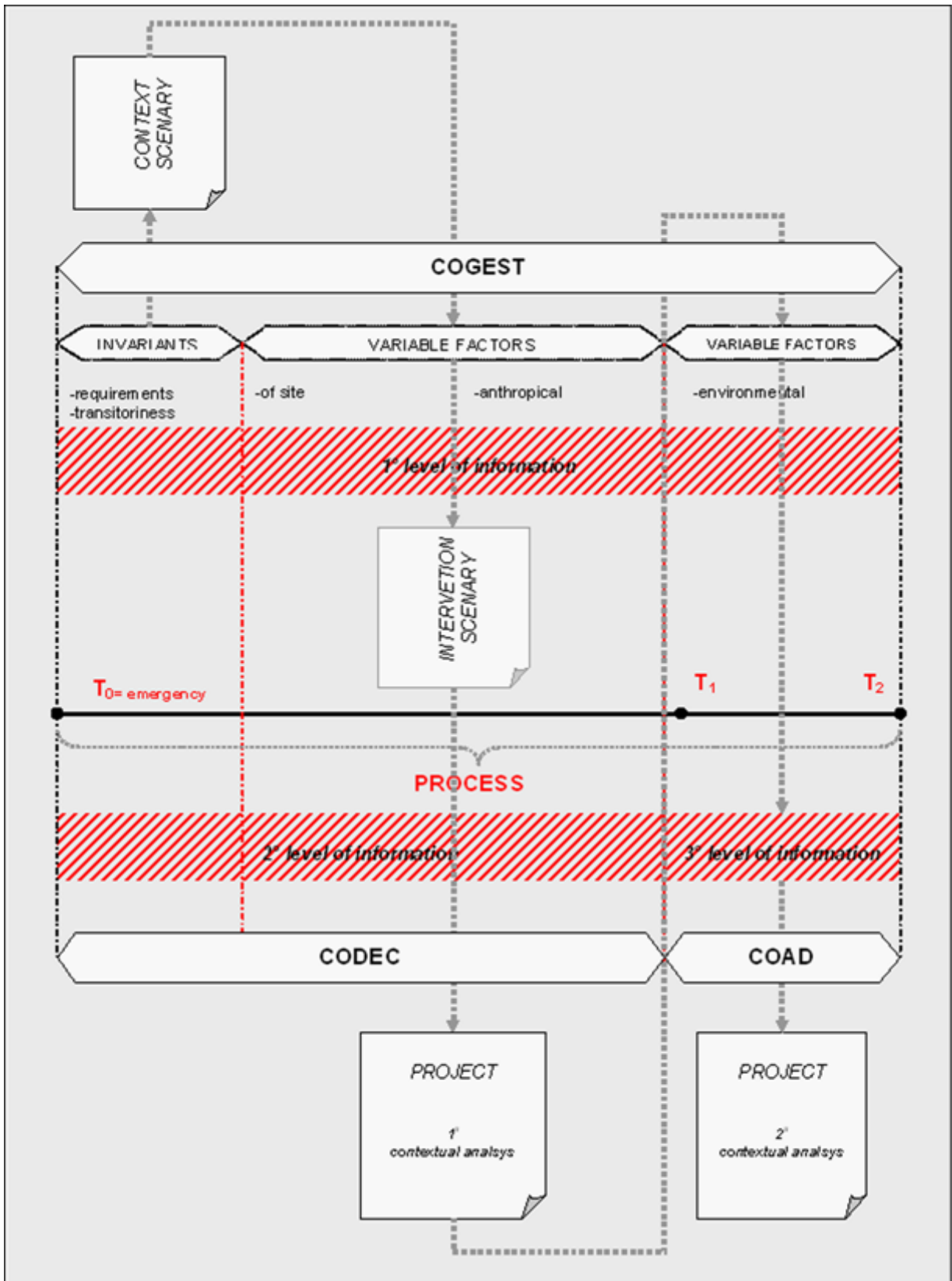


Figure 1 Organization and application sphere of Codes

It seems quite clear – thanks to the number of appointed national, supranational and independent bodies and organizations, and the analysis about the corresponding organizational structures⁶ – that great strides have been done in the field of Civil Protection, although these efforts concern first of all the first-emergency time (0 > 72 hours) and the matters about the right knowledge of territorial features, the typological and dimensional classification of the risk, the arrangement of shelter solutions that – created in order to face emergency more than temporariness – show their limits just when the emergency time persists⁷.

Very little has done – above all in Italy – in order to design a temporary housing system able not only to face emergency along the medium-long period, but also conceived in the frame of the reversible and sustainable approach to the building field⁸. Above all, one of the invariants during the interventions is the use of ad hoc housing forms, created for the emergency and represented by basically-closed systems, referring both to the integration by production, both to context – the environmental one (road network, orography, climatic zone, etc.).

These forms, substantially uninterested in the contextual features we said, show minimal housing standards that suffer further reductions because of their lack of compatibility between system\lodging and system\place as regards to the following analysis elements:

- Invariants, Exigency
- Kind of temporariness
- Contextual “Place” variables
- Process and/or Project directions
- Contextual “Anthropic” variables
- Climatic variables

The managing instrument for a reversible intervention shows itself as an answer to a complex matter just like the intervention management to offer lodging is, and it could represent:

- a model to plan all the activities needed to carry out the intervention;
- a study instrument, able to verify the planned processes and create new procedures to improve or re-plan them, investing all the processes somehow involved with offers;
- not a standard, pre-packed solution, but an “adaptive” one, coming by a dynamic process, open to the external inputs.

All the information we mean to organize with the Managing Code are referred to Process in its complexity, from resources’ management (material, human, economical)⁹, to their allocation and organization.

The more this instrument gives full information, the more administrators have an operating strategy at their disposal to schedule a transitory intervention, able to manage their choices in both general, typological and organizational level¹⁰.

This instrument shows itself as a guideline in which the data involved in the informative system make a first selection about: the settlement features, the functional and technological compatible typology regarding some 1st level parameters or, better, the demand typology, the pre-existing tissue and the actual status, the climatic context and, more, the valued slot.

THE PROJECT DECISION CODE

From the planning of the post-disaster emergency intervention, and all the linked activities – shown in the Managing Code – we reach the step referred to the definition of the functional and planning features at building level, fully-contextualised as regards event's peculiarities generating the demand of intervention. Indeed, the Managing Code - here named as CoGest - stands for a data managing instrument, giving a clear classification of the available data as regards intervention's meaning factors or, better, the actual status and the identified resources, but also as a first level guideline to design the temporary and reversible building. As regards the CoGest, the CoDec stands for an evolution about the data analysis, because it's able to manage decisions at the system design level, where the system is the emergency building. The process in its complex base itself on the design hypothesis of a building spatially and technologically defined at 70% - a level coinciding with the definition of "demand" with its own typological and topological characters¹¹. The right individuation of the right choices for this level needs a system coordinating the available data, managing planning decisions at the level of the functional organization of the spaces and translation in a technological congruent system.

This instrument works through classifying parameters in three inter-connected macro areas, in which designer's choice is supported by data consequential analysis: Typology, Physical Context, Anthropic Context; in other words, it gives the right key to translate the information collected in the first phase (CoGest) in the organization of a decisional process.

THE PROJECT ADAPTIVITY CODE

From the definition of emergency settlement and temporary housing form's formal features, we reach the step referred to the individuation of cover's best configuration as to context's climatic status. Functional to this activity, is the use of the virtual store, the interface between design and production.

1st Step\Starting data (invariables)

This code's application field is the housing system, pointed with the previous analytic phases or, better, a system defined in its technological and spatial level as regards some "first level" parameters, which settle the matters about use destination and global running.

This model's aim, so, is to support the final phase in designing the whole system, thanks to its adaptability to the context, which is continuously changeable as to demand's localization, regarding the environmental comfort features connected to climatic variations.

2nd Step\Variables

In this step we need to connect context's climatic features with the right intervention strategies, to be re-translated in project information (see tab.1).

Tab 1 Strategies of implementation performance of the covering

I.S.	IMPLEMENTATION STRATEGY: <i>variant system</i>		
climate	Strategy		Planning directions
COLD	Insulation	S.I.1	– Thermal insulation of the entire outside division
	Thermal gain	S.I.2	– The windows are localized on the surfaces exposed to the east and west
TEMPERATE	Insulation	S.I.3	– Insulation of the outside walls exposed to north
	Thermal gain	S.I.4	– The windows are localized on the surfaces exposed to south
HOT- DRY	Cooling	S.I.5	– Increasing of the thermal inertia of the outside walls
	Management of the solar incident radiation	S.I.6	– Reduced size of the windows
		S.I.7	– Use of shields
HOT- HUMID	Ventilation	S.I.8	– The position of windows have to facilitate the establishment of streams of air
	Management of the solar incident radiation	S.I.9	– Use of shields
	Management of rain water	S.I.10	– Draining system of rain water
		S.I.11	– Defence system

3rd StepField delimitation – Adaptivity Code’s field

The instrument application gives project information about two different operational fields, coming from object’s contextualisation (the temporary and reversible housing system) as regards to intervention area’s climatic features.

Both the first field, and the one considered aiming to the experimental verification of the instrument itself, is referred to cover’s answer in order to keep environmental comfort; the second one provides “auxiliary” information referred to compatible plant design’s integration with the selected environmental features¹².

4th Step Translation

In order to satisfy the pointed adaptivity strategies, it’s necessary to specify an application field, that could be translated in the definition of the performing features owned by the technological system, referring to building object’s decomposition:

- CV\ External Vertical Closure
 - CVia → Internal Isolation\panel system’s insulating features
 - CVib → External Isolation\covering system with insulating features
 - CVic → External Isolation\ ventilated wall syste
 - CVsa → Protection against atmospheric agents\mat covering system
 - CVsb → Protection against sun radiation\screening system
 - CVsb1 → (Firm Screens)
 - CVsb2 → (Mobile Screens)

- CS\ Upper Closure
 - CSia → Internal Isolation\ panel system’s insulating features
 - CSib → External Isolation\ covering system with insulating features
 - CSsa → Protection against atmospheric agents\pitched roof covering system

CSsb → Protection against sun radiation\screening covering system
CSsb → Protection against sun radiation\ventilated covering system

- C\ Lower Closure
Clia → Internal Isolation\ panel system's insulating features
Clib → External Isolation\ ground-fixed lifted system
- I\ Plant design's Integration
lia → Sun plant
lib → Photovoltaic plant
lic → Rain catching plant

Operation of the tool (fig.2)

Typology of implementation of the environmental performances according to the climatic context:

- the system is based on one "invariant structure" expounds the structural function and also the "varying structure", that constitutes the active covering of the building with the function of mediation with the external environment. This last one is defined and individualized in the beginning of the individualization of the climatic context and of the strategies related to the corresponding implementation.

Individualization of the covering partitions involved in the implementation:

- for an individualization of a climatic scenery which corresponds to the individualization of the covering partitions, that participate in the improvement of the environmental performances of the confined space.

Individualization of the products for the house building corresponding to the strategies of implementation individualized:

- the present phase occurs with the support of a informatics tool, defined a Virtual Store.

The tool is constituted by two data-bases:

- user / are constituted by file cards containing characteristics of the proposal and the corresponding codes for the strategies of implementation applications.
- production / is constituted by file cards containing the characteristics of the production and labelled with a corresponding code to the typology of implementation which they correspond to.

Selection of the offer (resources for the house building):

the choice of the system or the ideal component to acquit to the typology of implementation depends on some voices contained in the file cards:

- index of reversibility / the informatics tool sends to the file cards of implementation, which to parity of code of implementation, introduces the value of a higher reversibility. Such a value is esteemed through the compilation of some parameters which correspond to a judgment of value.
- availability / number of available units in a period of determined time.
- cost / unitary price.

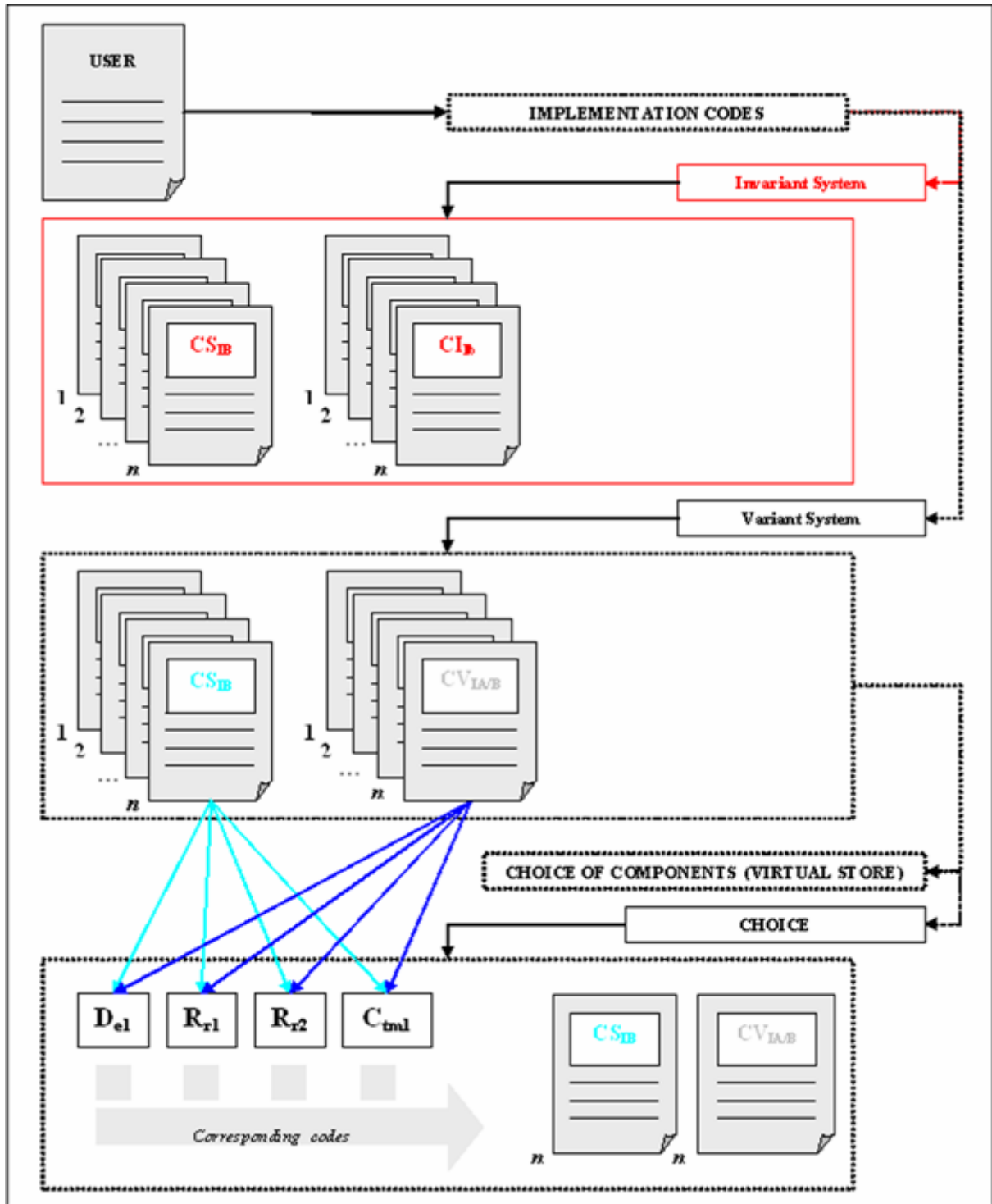


Figure 2 Functional Scheme of Adaptability

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¹ Phd: "Strategie per il controllo e la progettazione dell'esistente", Co-ordinator Prof. Attilio Nesi, XVII cycle.

² Group of research TEMENOS: TEcnologie, MEtodologie, Normative, Sostenibili (e-mail: temenos@unic.it), co-ordinator Prof. R Giuffrè. University of Reggio Calabria – DASTEC.

³ Alfarano, G. (2002). "Il progetto in trasformazione: l'orizzonte temporale e la reversibilità del costruire", in Bologna, R., "La reversibilità del costruire. L'abitazione transitoria in una prospettiva sostenibile", Maggioli editore, Rimini.

⁴ Interval of individuated time for the definition of the intervention sphere (medium – long period) answers to the need to cover an evident gap in the sector of the shelter interventions for post – disaster, nearly always, created as an immediate answer for emergencies in which the housing standards offer some compatibilities with a performance limited in time (72 hours – 3 months).

⁵ The methodological tool at the base of the present proposal is the result of the phd Thesis in Technology of Architecture: Grasso, M. R. (2005). "The reversibility as a tool for the management of the resources for the transitory architectural project: a proposal of implementation of drafts dealing with the project for the valuation of the intervention reversibility level", University of Reggio Calabria.

⁶ In 1980, Date of the earthquake in Irpinia, nearly nothing existed of the present organization that help, today, to manage the different associations present in the territory (armed forces, humanitarian organizations, health, local authorities and voluntaries) and is able to predispose the recovery and the prime recovery of the damaged in a time of 12 hours, comparing to the 30 days necessary in 1980.

⁷ The experience of the earthquake at Belice, at Umbria and Marche and the flood of Sarno, demonstrates how the installation projected to last about a few months have continued to be used for housing purposes even years after the calamitous event, starting an onerous process of obsolescence and dissatisfaction of the user.

⁸ In this field, the Provincial Administration of Florence, in collaboration with the University, has activated a series of activities aimed at the knowledge of the territory, also the formation of the staff, in particular in the area of the project, spread over the territory and applied to the development of a system founded on the concept of reversibility regarding constructions. Other information can be found, in M. Migliorini, The reversibility regarding constructions: new perspective of the role of the civil protection, in Bologna, R., "La reversibilità del costruire. L'abitazione transitoria in una prospettiva sostenibile", Maggioli editore, Rimini.

⁹ The number of the answers regarding post-disaster emergency depend, like any "project", on the preciseness of the hypothesis from the start. The phase of the programming therefore requires an

careful analysis of the dates of the problem, that in the case of an intervention post-disaster includes many factors: from the structural requirements exactly from the building typology requested (temporary module) to a context socio-productive connected, until the peculiarity of the climate.

¹⁰ The instrument addresses a particular category of user, that we can define, first level category, like done in precedence to individualize the type of information provided, represented by the manager of the intervention or "customer". In the specific case, emergency, the customer is represented by the Civil Protection and by the Association provided to manage the emergency and the economic resources allocated, like defined by the roles (legge 225/1992."Istituzione del Servizio Nazionale di Protezione Civile", art.6).

¹¹ The percentage of 70% is referred to the definition of the manufactured object about the characteristics of the structural system and the covering base.

¹² The elaborated indications are about the individualization of intervention strategies, not exhaustible by the indication of a corresponding product, but that enter in the most complex problems of the project, because involve problems like: the level of precipitation, exposure of the area, etc.. For this reason the typology of implementation related to the plants don't build materiel for the Virtual Store.