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(De)construct for Circular Economy

(Des)construir para a Economia Circular

WP 7 – Information, awareness and training

Activity 7.2 – Participatory actions for municipalities and construction companies

Participatory Workshop – results from Session A

Construction and demolition waste management by *Baixo Alentejo* construction companies – constraints, solutions and training needs

Final report

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1. Introduction

As part of the (De)construct for Circular Economy project, promoted by CIMBAL – Comunidade Intermunicipal do *Baixo Alentejo*, the participatory workshop "Construction and demolition waste (CDW) management by *Baixo Alentejo* construction companies – constraints, solutions and training needs" was held on April 28th of 2021. This workshop was part of the work package (WP) 7 – Information, awareness and training, led by FCT NOVA (NOVA School of Science and Technology), more precisely Activity 7.2 – Participatory actions for municipalities and construction companies.

The methodology for WP 7 was previously developed by FCT NOVA, complemented with contributions from project partners (FCT NOVA, 2021). For the workshop, two specific groups were selected, namely *Baixo Alentejo* municipalities and micro and small construction companies, because specific constraints for CDW management have been identified, especially in the last decade, for these types of stakeholders (Martinho *et al.*, 2013; European Commission, 2017; Ramos & Martinho, 2017; Ramos *et al.* 2020).

This workshop with *Baixo Alentejo* construction companies is the first of three sessions scheduled to present and discuss the following specific themes:

- Session A: the current workshop, about constraints and solutions for CDW management, as well as the training needs identified by the participants;
- Session B: in articulation with WP 2 and regarding the common legal framework to be developed for *Baixo Alentejo* region, focused on CDW management and the application of the circular economy principles to the construction sector, which is expected to happen in August 2021;
- Session C: in articulation with WP 6 and concerning the creation of a regional circularity strategy for the construction sector, scheduled for January 2022.

Within WP 7, and in articulation with other WP of the project, namely with WP 3 – Materials passport, WP 4 – Pre-demolition audits, WP 5 - Model (for the reuse of construction materials and CDW recycling), and also WP 6 – Proposal for strategic action, it is intended to consult other players from the construction sector, namely: the national and regional waste management authorities (Portuguese Environment Agency and the Alentejo Regional Coordination and Development Commission, respectively), construction sector associations, regional waste management operators, among other actors previously identified, that will be validated and complemented later.

This report presents the results from the participatory activities carried out in the scope of the *Baixo Alentejo* construction companies' workshop (Session A), and is structured in the following chapters:

- Introduction (current chapter);
- Programme, workshop dynamics and participants (chapter 2);
- Results of activities (chapter 3);
- Workshop evaluation (chapter 4);
- Conclusions (chapter 5).

2. Programme, workshop dynamics and participants

2.1. Programme

This participatory workshop (Session A), with *Baixo Alentejo* construction companies, took place on April 28th of 2021, by videoconference, due to Covid-19 pandemic restrictions (images of the workshop in Annex I). The programme and contents are described in Table 1. The programme was structured in one presentation component and four participatory activities.

Table 1. Programme of the workshop with construction companies, objectives and responsibilities.

Programme		Main objectives	Responsibilities in the workshop
09h00	Opening session.	– Opening session; – Contribution and importance of the involvement of *Baixo Alentejo* construction companies in the project.	CIMBAL *(promoter)*
09h10	Presentation of the FCT NOVA team and the workshop programme.	– Brief presentation of FCT NOVA team and projects regarding CDW management and participatory actions developed in the last decade; – Presentation of the workshop programme.	FCT NOVA
09h15	Presentation of the project, WP 7 and its activities.	– Brief presentation of the project, WP7 framework (Information, awareness and training) as well as Activity 7.2 (Participation actions).	FCT NOVA
09h25	Activity 1 (individual)	– Activity 1: reflection on the behaviours of construction companies related to CDW management.	FCT NOVA and construction companies
09h55	Activity 2 (individual)	– Activity 2: training needs for construction companies.	FCT NOVA and construction companies
10h10	Expository component: Reflection on the challenges about CDW management by construction companies	– Topics concerning the challenges regarding CDW management for the construction companies, as an introduction to Activities 3 and 4 (see list of contents in the subchapter 2.2).	FCT NOVA
10h25	Activities 3 e 4 (in group)	– Activity 3: CDW management constraints for construction companies; – Activity 4: solutions proposal identified by construction companies and to be implemented by the municipalities for the resolution of CDW management constraints.	FCT NOVA and construction companies

Programme		Main objectives	Responsibilities in the workshop
11h00	Debate.	– Debate.	FCT NOVA and construction companies
11h15	Session closure.	– Session closure.	CIMBAL and FCT NOVA

2.2. Workshop dynamics

The participatory workshop (Session A), that took place by videoconference (due to Covid-19 pandemic restrictions), was planned and organized taking into account two main and interrelated elements, namely the presentation component and the participatory activities.

Exhibit component

In the workshop, one presentation component was held, introductory to Activities 3 and 4 (construction companies CDW management constraints and proposed solutions to be implemented by the municipalities, respectively). The main contents are listed in Table 2.

Table 2. Contents' list of the presentation component of the workshop.

Expository component	List of main contents
Topics concerning the challenges about CDW management by construction companies (introductory to Activities 3 and 4)	– The main construction sector environmental impacts (focus on material extraction, CO_2 emissions and CDW generation, in the European Union); – The CDW physical composition in Portugal, highlighting the mineral fraction; – The CDW recovery industrial plants and the facilities at a municipal level with the capacity to receive and store CDW; – The recycled aggregates market and issues related to confidence in the use of recycled materials and the perception of customers about their use; – CDW illegal dumping in the municipalities of *Baixo Alentejo,* Portugal, and in the municipality of *Timisoara*, Romania (presentation of the main results obtained in the monitoring work developed during March 2021, within WP 1 – Baseline situation analysis and follow-up); – The size of construction companies in Portugal reality, with 95% of micro and small companies, and some associated constraints; – The CDW management good practices, with a focus on practical aspects: hazardous CDW storage at construction works; mandatory CDW sorting on construction sites (the new legal obligations that will come into force from July 1st of 2021) and the advantages in terms of costs for the sorting of the mineral fraction; the mandatory use of electronic monitoring waste guides (e-GAR) in the CDW transport; the reality of surveillance/supervision actions in Portugal;

Expository component	List of main contents
	– Awareness, along the themes referred in the previous point, to the applicable penalties' values, in case of non-compliance with the aforementioned legal requirements.

Participatory activities

During this workshop with *Baixo Alentejo* construction companies, the following participatory activities were organized (the assessment adopted criteria will be presented more detailed together with the results analysis, in order to facilitate the understanding; in chapter 3, in general):

- Activity 1 (individual): reflection on the behaviours of the construction companies regarding CDW management (specifically in subchapter 3.1);
- Activity 2 (individual): training needs for the construction companies (specifically in subchapter 3.2);
- Activity 3 (in group): identification of internal and external constraints for CDW management by construction companies (specifically in subchapter 3.3);
- Activity 4 (in group): solutions proposal identified by construction companies and to be implemented by the municipalities for the resolution of CDW management constraints (specifically in subchapter 3.4);
- Complementary data (individual): each construction company was asked about the municipality of where the headquarters of the company is located (in the header of Activity 1 form), as well as to register, for the last 12 months, the municipalities where they carried out the majority of construction works, in order to understand the dynamics of the construction activity for these companies (specifically in subchapter 3.5).

To carry out the participatory activities described above, participants were asked to record their responses on specific forms, in paper, that were previously printed by the municipal representative of the project, who also attended the workshop (see the participants organization in the participatory activities, in subchapter 2.3).

Methodological approach underlying Activity 1

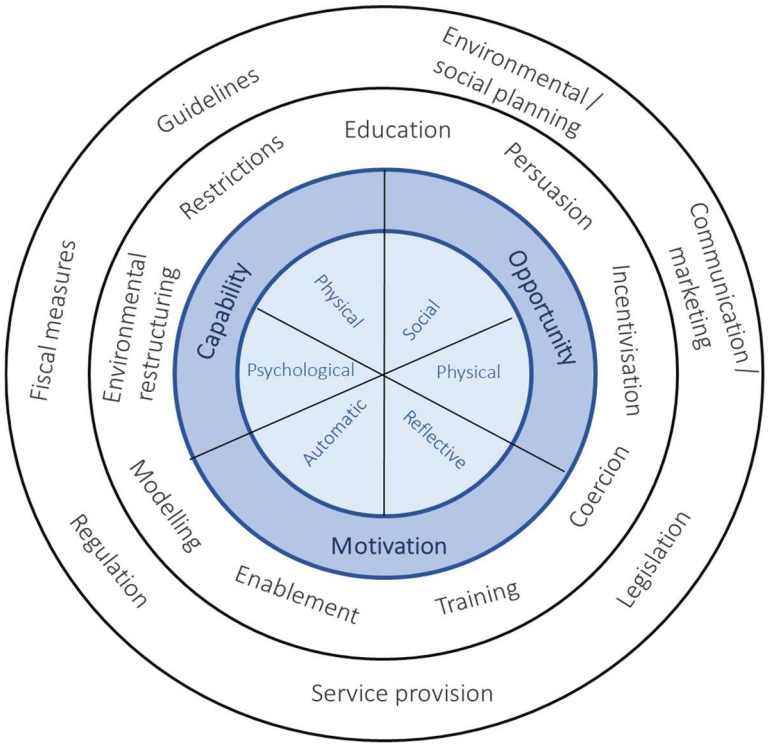
For the development and implementation of Activity 1, the evaluation method was supported by the Behavioural Change Wheel (BCW), developed by Michie *et al.* (2011), which relates behaviour change with three main components (capability, motivation, and opportunity), subdivided into subcomponents, namely (Figure 1):

- Component "**capability**": subcomponent "physical" (*i.e.,* whether there is the physical capacity to execute), and subcomponent "psychological" (*i.e.,* if there is the knowledge to perform it);
- Component "**motivation**": subcomponent "automatic" (*i.e.,* whether the behaviour is dependent on an instinctive/reactive decision or acquired habits), and subcomponent "reflective" (*i.e.,* if the

behaviour derives from thoughtful attitudes, as for example reflection on the consequences of the action); and

- Component "**opportunity**": subcomponent "physical" (*i.e.,* existence of physical resources available to carry out the actions), and subcomponent "social" (*i.e.,* whether the behaviour is influenced, for example, by the behaviour of an entity/authority or by a group).

The behaviour study associated with each of the components is important to define in which priority axes the actions should be based to fulfil the identified flaws, as well as the instruments to be used.



Source: adapted from Michie et al., 2011

Figure 1. Behavioural Change Wheel.

The model presented was adapted to the behaviours of construction companies with CDW management influence. To conduct the behavioural assessment, 30 questions were asked to the participants (on a positive approach), requiring them to position themselves in relation to each question, on a 6-point Likert scale (between 1 "strongly disagree", and 6 "strongly agree"). The questions were organized into four groups, that are representative of the components where it is considered that the behaviour of the construction companies may have an influence regarding CDW management, addressing the themes summarized in Table 3.

Table 3. Topics covered in Activity 1, referring to the behaviour of construction companies about CDW management.

Groups	Topics covered, taking into account the main components and subcomponents of the BCW
CDW management on construction sites planning.	– Capability in terms of knowledge that allow to estimate the quantities and types of CDW to be generated in the construction phase, as well as the costs with their management; – CDW management motivation, either because it is a usual company practice, or because it comes from the reflection on the possible cost reduction; – Opportunity to act given the existence in the company of human resources with adequate CDW management knowledge, or due to the facilitated access to clarify doubts about CDW management (internal or external sources).
CDW sorting and storage on construction sites.	– Capability to act, taking into consideration the existing knowledge about CDW sorting legal obligation at construction sites, as well as about the responsibilities of supervisors (on supervising CDW management practices); – Motivation to separate and store the generated CDW (or not), as it is a common practice of the company, or because it arises as a result of reflection about the legal obligations, the eventual and consequent cost reduction, or due to the existing relationships with the agents responsible for surveillance/supervision actions (feeling of impunity); – Opportunity to intervene taking into consideration the ease resources access and equipment that enable CDW sorting and storage on construction sites.
Reuse of construction materials and incorporation of recycled materials.	– Capability to reuse construction materials, or to incorporate recycled aggregates, considering, in this last case, the knowledge about the compliance with the legal requirements in force, namely in terms of the standards and technical specifications; – Motivation in the use of recycled aggregates due to the fact that the confidence in the use of these materials is a company conviction, since the practice is well perceived by the customer, or just because it is advantageous in terms of the environment.
CDW transport and final destination	– Capability, in terms of knowledge, to know that is mandatory that CDW transport must be carried out with an electronic monitoring waste guide (e-GAR), that CDW has to be sent to a licensed final destination, and that CDW illegal dumping has a high penalty value; – Motivation to send CDW to licensed waste management operators, because is a company habit, or there is a concern to ensure the correct treatment of CDW, or even because there is a feeling of unease due to CDW illegal dumping (performed by the company itself or because it is a practice performed by other companies); – Opportunity to give an appropriate final destination to CDW since storage solutions are often available (or the opposite, leading to CDW illegal dumping), but also the perception of the importance attributed by society to this matter, and whether information, awareness and/or training campaigns often address this issue.

Legend: BCW (Behavioural Change Wheel).

Workshop evaluation

After the participatory workshop (Session A), each participant was asked to evaluate what they liked more and less, to give suggestions for the improvement of the next workshops, as well as to rate their satisfaction, in general. These contributions, and the comments of FCT NOVA, are presented in chapter 4.

2.3. Organization and characterization of participants

Organization of participants in the participatory activities

This participatory workshop (Session A), with the micro and small construction companies of *Baixo Alentejo* region, was expected to take place in a face-to-face model. However, due to the restrictions associated with the Covid-19 pandemic, it was necessary to perform it online.

Prior to the workshop, several contacts were made with construction companies with its headquarters registered in each municipality. The contacts were performed by the municipal representative for the project, jointly with other municipal technicians, to find out their interest in contributing to the project. Only construction companies with a certificate or with a construction permit title until Class 5 could participate, so the focus was on micro and small construction companies, as established before as a methodological objective for the workshop (see methodological approach in FCT NOVA, 2021). The contact approaches differed depending on the municipality, due to the different existing realities. After defining the date and time of the workshop, as well as its duration (which was reduced to allow the participation of more construction companies), a new participation interest verification was performed.

For the organization of the workshop itself, each municipality was previously asked to gather the construction companies in a common physical space, considering the physical distance imposed by the security restrictions due to the Covid-19 pandemic, and to ensure a good image and sound conditions, to have a good involvement in the participatory activities.

The participants were divided into (virtual) rooms, trying mainly to reduce the entropy generated by different dimensions groups. Forty-one representatives of *Baixo Alentejo* micro and small construction companies participated in the workshop, distributed through the (virtual) rooms in accordance with the registration established in Table 4. Regarding the municipalities of *Beja, Cuba* and *Ferreira do Alentejo* it was not possible to have the participation of these municipalities' construction companies. However, for the next workshops, a new effort will be made to try to bring companies from these municipalities to contribute to the project.

Table 4. Distribution of participants in the participatory activities, by municipality.

Room (virtual)	Municipalities	N.º participants (representatives of construction companies)
1	*Aljustrel*	4
2	*Almodôvar*	17
3	*Alvito*	2
4	*Barrancos*	2
5	*Castro Verde*	4
6	*Mértola*	1
7	*Moura*	1
8	*Ourique*	4

Room (virtual)	Municipalities	N.º participants (representatives of construction companies)
8	*Serpa*	1
10	*Vidigueira*	5
Total		**41**

Characterization of participants

The companies were asked, when completing Activity 1 form, to register if they have a construction activity certificate, or if they are qualified with a construction permit class title, indicating in this case which class. Only one company replied having a certificate and the remaining 40 indicated the respective construction permit class or did not answered, as shown in Figure 2.

Regarding the companies that mentioned to have a construction permit class, class 1 and 2 are predominant (51%, in total), followed by companies with permit classes 3, 4 and 5 (12%, 5% and 3%, respectively). This reality also reflects the selection criteria for the participant construction companies, to fit into the category of micro and small companies. On the other hand, 12 construction companies did not answer (29%), which may be due to distraction (although they filled in other fields in the Activity 1 form), uncertainty about the construction permit title, or even irregular situations that, due to option, have not been reported.

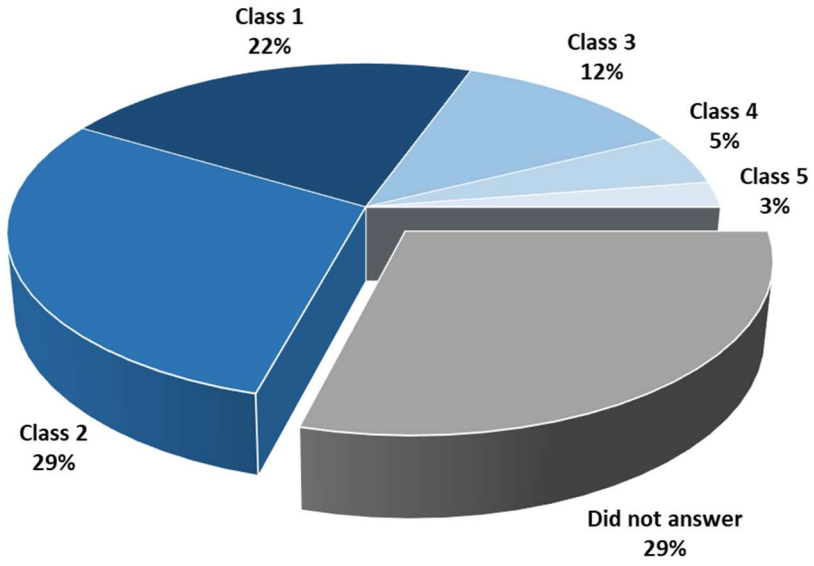


Figure 2. Distribution of participants, by construction permit class.

3. Results of activities

3.1. Activity 1 – reflexion on the behaviours of construction companies

This activity focused on the individual reflection, of each participating construction company, regarding the CDW management behaviours adopted, taking into consideration the methodological approach mentioned in subchapter 2.2, namely the Behavioural Change Wheel approach (Michie *et al.*, 2011), in this case adapted to the construction companies' reality. For practical purposes, the analysis of the results was subdivided into four groups, representative of the components where it is considered that the behaviours of the construction companies may have more influence regarding CDW management (Table 3, also reproduced in Table ***5***).

It is reminded that companies were asked to position themselves in relation to 30 statements (on a positive approach) on CDW management behaviours, using a 6-point Likert scale (between 1 "strongly disagree", and 6 "strongly agree"). The main results express, through the average values, the greater or lesser agreement of the 41 participants in relation to the statements made.

Table 5. Reflexion on the behaviour of construction companies regarding CDW management.

Groups	Behaviour of construction companies, taking into account the main components and subcomponents of the BCW
CDW management on construction sites planning.	– The companies demonstrate more knowledge gaps related to CDW management costs estimation (3,7 average) than with the quantities and types of CDW estimation that a construction work will generate (average of 4,4).
	– The costs reduction through the correct CDW sorting is a motivation for part of the companies (4,5 average), but it must be also considered that several companies still do not often include in their budgets the CDW management costs (4,2 average).
	– Companies lack skilled workers, with knowledge regarding CDW generation estimation and its costs (3,5 average), as well as the opportunity to try to overcome the weakness of not having frequent and facilitated access to the clarification of doubts about CDW management, from internal or external sources (3,7 average).
CDW sorting and storage on construction sites.	– There is a good level of knowledge about the mandatory legal requirement regarding CDW sorting on construction sites (5,3 average), the proper CDW containing asbestos management (5,5 average) and, although in a less expressive way, the fact that surveillance/supervision entities have the competence to supervision procedures regarding CDW management (4,9 average).
	– There is a motivation from most of the companies for CDW sorting at construction sites, as they assume it is a frequent practice in the company (5,2 average), also contributing to this behaviour the legal obligation to proceed in this way (5,2 average) and, to a lesser extent, the costs reduction associated with this waste stream management (4,8 average); – A part of the companies recognizes that there is a close relationship with the supervisors, who can be understanding about irregular situations regarding CDW management (4,7 average).

Groups	Behaviour of construction companies, taking into account the main components and subcomponents of the BCW
	– Only part of the companies can easily provide equipment to properly store CDW on construction sites (4,0 average).
Reuse of construction materials and incorporation of recycled materials.	– In terms of knowledge, most companies recognize that they have to comply with standards for the use of recycled aggregates (5,0 average).
	– A good part of the companies respond that they feel motivated to reuse construction materials (4,9 average); – For the use of recycled aggregates, a good part of the companies feels motivated to do it, due to the confidence they feel in these materials (4,6 average), but also several companies are reluctant to use recycled aggregates due to the customers perception (4,0 average).
CDW transport and final destination.	– In terms of knowledge, a good part of the companies recognizes knowing that CDW transport has to be accompanied by an electronic monitoring waste guide (e-GAR) (4,7 average), that has to send CDW to final licensed destinations (4,8 average), and that the penalties have a very high cost for those who practice CDW illegal dumping (5,0 average).
	– It is a motivation for part of the companies to use electronic monitoring waste guides (e-GAR) due to the perception that they are frequently supervised (4,4 average), to send CDW to licensed waste management operators as a common practice (4,4 average), but also due to the fact that there is some concern about what happens to CDW in the final destinations (4,4 average).
	– Regarding the reality of CDW illegal dumping, companies recognize that they dump CDW less frequently and when it occurs is due to being unable to manage it at construction sites (absence of equipment and managing the associated costs) (2,4 average, which is the lowest average value recorded in this activity), but they also recognize, with considerable expression, that CDW dumpsites would be less frequent if there were more resources and infrastructures (5,4 average); – In addition, companies legitimize that there are few information and awareness campaigns that focus on the topic of CDW illegal dumping (3,3 average) and that, in general, society does not attribute great importance to these occurrences (3,8 average).

Legend: BCW (Behavioural Change Wheel).

3.2. Activity 2 – training needs

In this activity, carried out after Activity 1 (reflexion on the behaviour of construction companies about CDW management – see subchapter 3.1), each micro and small construction company was asked to register their training needs, using for this purpose a 5-point Likert scale (between 1 “very unnecessary”, and 5 “very necessary”), and taking into consideration different pre-selected topics, which pursued to cover the different aspects related to this specific waste stream management. The results were grouped and organised, in a training needs decreasing order of priority (Table 6).

The training topic that generates more consensus is related to CDW management good practices on construction sites, such as sorting, as well as the hazardous CDW management (4,4 average). The following topics regards the legal framework, general or about CDW containing asbestos (both averaging 4,1).

The topic indicating less need for training is the CDW transport and the use of electronic waste monitoring guides (e-GAR) (3,6 average). It should also be noted that topics relevant to circular economy implementation in the construction sector are also at the bottom of the ordered list, namely: the reuse of materials (3,8 average), recycled materials incorporation, such as recycled aggregates and, consequently, the application of technical specifications for the incorporation of these recycled materials (both options with an average of 3,9).

This hierarchy for micro and small construction companies training needs will be considered jointly with CIMBAL and with other project partners, mainly within WP 6, to define the strategy to fill the main knowledge gaps identified (also in articulation with the results of Activity 1 - see subchapter 3.1).

Table 6. Construction companies training needs (and its hierarchy).

Training needs, measured in a Likert scale between 1 "very unnecessary", e 5 "very necessary"	
Suggested training topic	**Average**
CDW management on construction sites good practices (*e.g.*, CDW sorting, hazardous CDW).	4,4
CDW legal framework (general).	4,1
CDW containing asbestos legal framework.	4,1
CDW final destinations (waste management operators/solutions).	4,0
CDW composition and identification (by European List of Waste[1] 6 digits codes).	3,9
Incorporation of recycled materials on construction sites (*e.g.*, recycled aggregates).	3,9
Technical specifications of the Portuguese Laboratory of Civil Engineering regarding CDW.	3,9
Reuse of construction materials onsite or in other construction works (*e.g.*, doors, tiles).	3,8
CDW transport and electronic waste monitoring guides (e-GAR).	3,6

[1] European List of Waste (ELW): Commission Decision 2014/955/EU, of 18 December, amending Decision 2000/532/EC on the list of waste, pursuant to Directive 2008/98/EC of the European Parliament and of the Council.

3.3. Activity 3 – CDW management constraints

In this group activity, and after the exhibit component (CDW management topics – subchapter 2.1, Table 1; and subchapter 2.2, Table 2), participants were asked to identify the constraints that micro and small construction companies perceive regarding CDW management, distinguishing it into internal and external constraints.

The specific constraints identified by each construction company were organized into wider groups (themes), ordered considering the decreasing order of responses' frequency. The frequency refers to the number of times that each constraint was identified, considering the contributions from the different (virtual) rooms (subchapter 2.3, Table 4).

Internal constraints

The internal constraints are those related to the construction company itself and the respective practices, and the contributions shared by the participants are summarised and ordered in Table 7.

Within the themes level, the ones that have the greatest consensus are: the implementation of CDW management, including sorting, collection, storage, transport and delivery to final destination, and those related to information, awareness and training, including technical monitoring work.

Analysing the results obtained regarding the specific internal constraints, the most mentioned concerns are the viability of transporting small CDW quantities to intermediate (storage) or final destinations, also due to the imposition of a daily limit on the quantity of CDW received by some municipalities. However, and although less frequently, specific internal constraints regarding the difficulty in implementing an appropriate space in the construction sites to accommodate different CDW types are also mentioned, the lack of information, awareness and training, and the difficulty in managing CDW associated costs.

Table 7. Internal constraints in CDW management identified by construction companies.

Internal constraints (IC)				Frequency	
Groups of IC		**Specific IC**		**n.º**	
IC-1	Constraints linked to CDW management implementation, including sorting, collection, storage, transport and delivery to final destination.	IC-1.1	Viability of transporting small CDW quantities to intermediate (storage) or final destinations, also due to the imposition of a daily limit on the CDW quantity received by some municipalities.	5	12
		IC-1.2	Difficulty in implementing an appropriate space on construction sites for sorting different types of CDW.	3	
		IC-1.3	Absence of equipment (general).	1	

Internal constraints (IC)				Frequency	
Groups of IC		Specific IC		n.º	
		IC-1.4	Difficulty about CDW sorting on construction sites (general).	1	
		IC-1.5	Limitations related, in particular, to the time consumed for CDW sorting.	1	
		IC-1.6	Limitations in the use of electronic monitoring waste guides (e-GAR).	1	
IC-2	Constraints related to information, awareness, training and technical follow-up/monitoring related to CDW management.	IC-2.1	Lack of information/training about CDW management issues (general).	3	9
		IC-2.2	Lack of knowledge, in particular about CDW management legal framework.	2	
		IC-2.3	Lack of knowledge, in particular regarding CDW management operators.	2	
		IC-2.4	Lack of technical follow-up concerning CDW management.	1	
		IC-2.5	Lack of skilled work force for CDW sorting on construction sites.	1	
IC-3	Constraints related to CDW management costs.	IC-3.1	Difficulty in internalizing CDW management costs.	3	4
		IC-3.2	Difficulty in allocating/planning CDW management costs.	1	

External constraints

External constraints are those that are dependent, for example, on other entities, regulatory guidelines, among other aspects. In Table 8 external constraints are registered and organized, by themes, according to the workshop participants answers.

Regarding the themes defined, the external constraints most mentioned are related with CDW delivery to appropriate municipal equipment/infrastructures. Although less frequently, also stands out the constraints related to the CDW management costs, as well as those linked to the CDW delivery to waste management operators.

Assessing the results, from the perspective of specific external constraints, it prevails the lack of adequate conditions for collecting and storing CDW in the municipalities.

Table 8. External constraints in CDW management identified by construction companies.

External constraints (EC)				Frequency	
Groups of EC		**Specific EC**		**n.º**	
EC-1	Constraints related to CDW delivery into appropriate municipal equipment/infrastructures.	EC-1.1	Lack of an appropriate site in the municipality, with adequate conditions for CDW storage.	7	11
		EC-1.2	Lack of incentives from the municipality to receive the CDW generated, for storage in a licensed site.	1	
		EC-1.3	Lack of containers to temporarily store CDW in the municipality.	1	
		EC-1.4	Limit imposed by the municipality to receive CDW on a daily basis (*e.g.,* up to 1 m^3/day).	1	
		EC-1.5	Difficulty in sending CDW that the municipality does not receive to other final destinations (*e.g.,* plasterboard, bags of cement).	1	
EC-2	Constraints correlated to CDW management costs.	EC-2.1	Difficulties in managing CDW costs (general).	2	5
		EC-2.2	Limitations in managing, in particular, the costs applied by waste management operators for CDW.	2	
		EC-2.3	Complexity in managing, in particular, the high costs associated with CDW transport.	1	
EC-3	Constraints related to sending CDW to waste management operators.	EC-3.1	Distance from CDW generation sites to treatment infrastructures (final destinations).	3	5
		EC-3.2	Lack of licensed operators for CDW collection, transport and recovery.	1	
		EC-3.3	Lack of more CDW management operators, in order to reduce transport costs and time spent on travels.	1	
EC-4	Constraints associated to surveillance/supervision actions by external entities.	EC-4.1	Lack of surveillance/supervision by SEPNA (Portuguese police authority with environmental surveillance/supervision responsibility).	1	2
		EC-4.2	Unfair competition from other companies performing CDW illegal dumping, not internalizing the costs associated with its management.	1	
EC-5		EC-5.1	Considerable distance from CDW crushing solutions (production of recycled aggregates).	1	2

External constraints (EC)				Frequency	
Groups of EC		**Specific EC**		**n.º**	
	Constraints linked to the use of recycled materials.	EC-5.2	Difficulty in internalizing the high cost of recycled materials.	1	
EC-6	Constraints inherent to the territory characteristics.	EC-6.1	Lack of space on construction sites, with the appropriate conditions to carry out CDW management, especially in areas with urban characteristics.	1	1

3.4. Activity 4 – solutions to improve CDW management

Subsequently to the identification by *Baixo Alentejo* construction companies of the constraints (internal and external) associated with CDW management, participants in this group activity were asked to suggest solutions to be implemented by municipalities to solve or mitigate the identified problems. The results are registered in Table 9.

The solutions presented were structured by themes and organized considering the decreasing order of responses frequency. The frequency refers to the number of times that each solution was identified in each (virtual) room (see subchapter 2.3, Table 4).

Within the defined themes, it stands out the necessity to create appropriate temporary storage sites in the municipalities to carry out CDW management (CDW with municipal management responsibility), but also to store construction materials for reuse, for which there is not often enough space for managing it at construction sites. Although less frequently, there is also a need to provide resources and equipment to facilitate CDW temporary storage, the promotion of the recycled aggregates market, as well as information, awareness and training campaigns about CDW management.

Analysing the specific solutions, individually, it stands out the necessity to create appropriate sites in municipalities for temporary CDW and construction materials storage. Although less frequently, it is also worth mentioning the availability of resources and equipment for CDW sorting on construction sites (*e.g.,* big-bags, containers), the investment in the acquisition of CDW crushing mobile units to produce recycled aggregates (a collective use solution), and carrying out information, awareness and training actions.

Table 9. Suggestions of construction companies about how municipalities can support CDW management.

What can the municipality do to help the construction company in CDW management?				How will the proposed solution support the construction company in CDW management?	Frequency	
Groups of solutions		**Specific solutions**			**(n.º)**	
S-1	Create a collection and storage site in the municipality, to manage the CDW with municipal management responsibility, but also to store construction materials, for the reuse in other construction works, when there is no storage capacity at construction sites.	S-1.1	Creation of a site in the municipality for CDW collection and storage, but also for construction materials for reuse.	– Resolve the absence of an appropriate collection and storage site in the municipality, to manage the CDW with municipal management responsibility, as well as for the storage of construction materials for reuse; – Reduction of the time spent in travels regarding the shipping of CDW to the final destinations; – CDW transport costs optimization.	8	9
		S-1.2	Creation of synergies with the Municipal Waste Management Systems[2] in the region.		1	
S-2	Provide resources and equipment to facilitate the collection of CDW with municipal management responsibility.	S-2.1	Provide resources and equipment for CDW sorting and storage on the construction sites (*e.g.,* big-bags, containers).	– Proximity answer; – Solution for CDW generated in minor do-it-yourself construction and demolition activities within private households.	4	5
		S-2.2	Implement a door-to-door collection system for CDW collection in minor do-it-yourself construction and demolition activities within private households.		1	
S-3		S-3.1	Invest in the acquisition of a CDW crushing mobile unit to produce recycled aggregates.	– Solution for collective use, but helping the construction company;	3	4

[2] Municipal Waste Management System: an entity representing a group of municipalities, sharing waste management responsibilities, depending on a specific regulatory framework, as well considering the contracts established between the parties; they are also responsible for the waste treatment, because they are in charge of the waste management facilities (*i.e.*, recycling, disposal, waste to energy).

What can the municipality do to help the construction company in CDW management?				How will the proposed solution support the construction company in CDW management?	Frequency	
Groups of solutions		**Specific solutions**			**(n.º)**	
	Promote the recycled aggregates market.	S-3.2	Enhance the certification of recycled aggregates.	– Incorporation of recycled CDW in the original construction work or in other construction works.	1	
S-4	Inform, raise awareness and training regarding CDW management issues.	S-4.1	Carry out information, awareness and training actions about CDW management issues (general).	– Training the construction company work force, making it more aware about CDW management issues, including the associated costs optimization.	3	4
		S-4.2	Promote information, awareness and training actions focusing specifically on CDW legal framework.	– Ensure an adequate CDW management by the company, in compliance with the legal framework.	1	
S-5	Create incentives that help promoting the correct CDW management.	S-5.1	Create incentives that motivate companies to recycle more the CDW generated.	– Create dynamics that motivate the company to recycle more and better.	1	2
		S-5.2	Exempt from licensing fees appropriate dedicated spaces for CDW sorting and storage at construction sites.	– Promote the creation of adequate spaces for CDW management on construction sites.	1	
S-6	Promote surveillance/supervision actions.	S-6.1	Supervise construction companies to verify if they comply with the correct CDW management requirements, including the procedural control (*e.g.,* CDW Prevention and Management Plan, for public construction works).	– Create a level playing field for all companies, discouraging injustices and the feeling of impunity.	1	1

3.5. Complementary data – construction activity dynamics

Within the scope of Activity 1 (reflection on the behaviours of construction company related to CDW management), a question was incorporated in the activity form asking about the municipalities where the companies carried out most of the construction works in the past 12 months. This question was planned aiming to try to understand the construction activity dynamics of micro and small companies in *Baixo Alentejo* region that participated in the workshop. In the analysis, FCT NOVA tried to detail the construction activity considering the following territorial realities: municipality where the company headquarters are located, *Baixo Alentejo* subregion, *Alentejo* region, and other locations.

The results are presented in Figure 3, showing that from the 38 companies that answered this question, most of them carry out a proximity reality construction activity (in the municipalities of the headquarters of the companies or in contiguous municipalities), but mainly focused on *Alentejo* and *Baixo Alentejo* subregion (97% and 89%, respectively). Considering the construction activity in the municipality where the company headquarters is registered, the response frequency drops slightly to 79%. Only 1 company (3% of the answers) register to have carried out works outside *Alentejo* region, in this case in *Algarve* region (being, however, one of the mentioned municipalities contiguous to the municipality of *Mértola*, namely *Alcoutim*).

This analysis highlights the need to think about solution to CDW management, as well as to other aspects of the circular economy in the construction sector (*e.g.,* reuse of materials and incorporation of recycled materials), focused on this proximity construction activity reality.

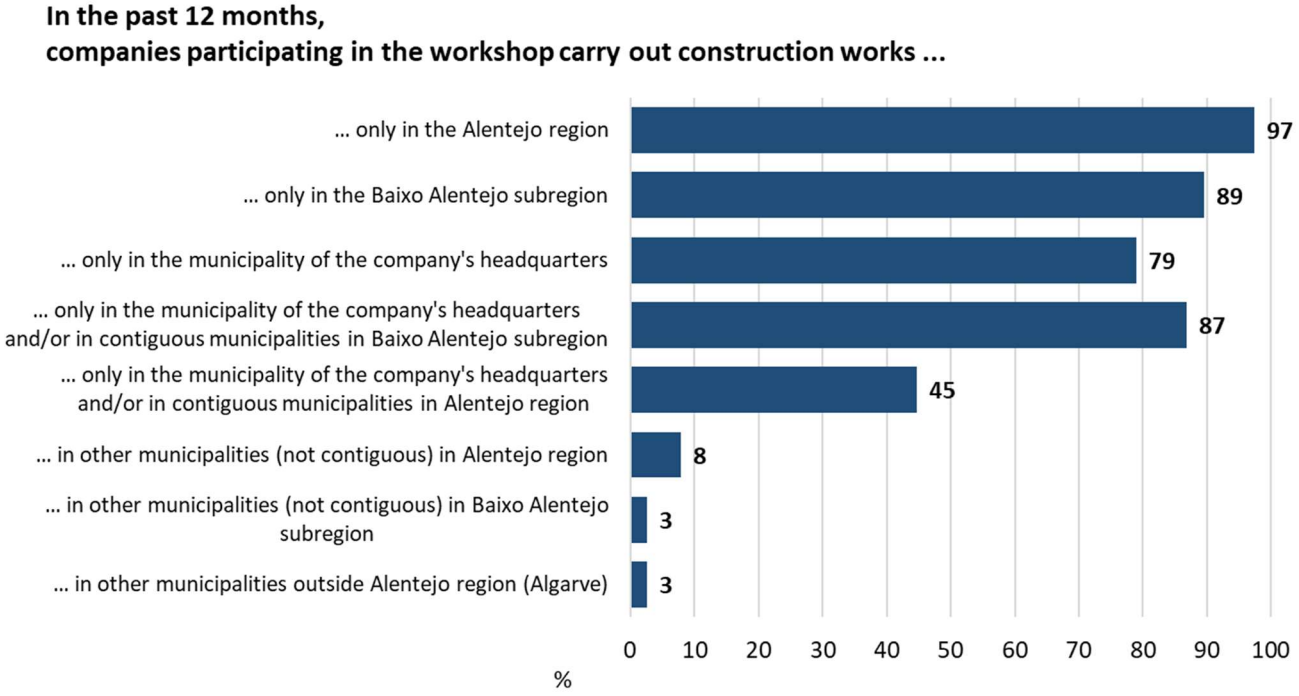


Figure 3. Construction activity dynamics of the companies participating in the workshop, in the last 12 months.

4. Workshop evaluation

Participants were asked to complete a form, in an anonymous and confidential way, regarding the workshop evaluation. Thirty-six responses were received (response rate of 88%), and the overall evaluation of the workshop, measured on a 7-point Likert scale (between 1 "very bad", and 7 "very good"), was 5,8 (see details of the evaluation in Figure 4.

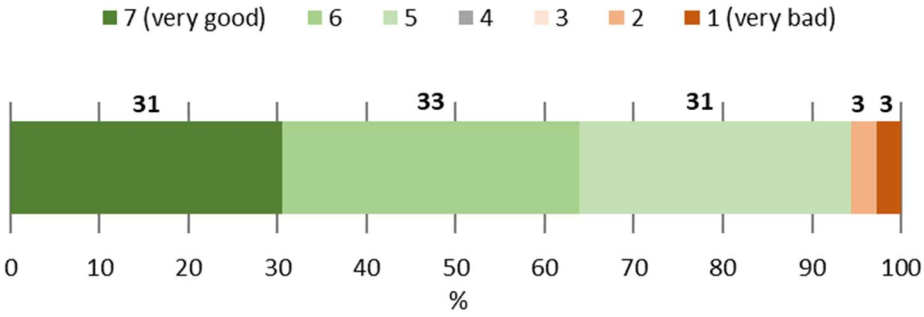


Figure 4. Overall evaluation of the workshop with the companies, in relation to the participants who responded.

The results are detailed below, where comments from the FCT NOVA team are also presented:

- What the participant liked more and less, according to pre-selected options, but allowing to add other choices, and accepting, in both cases, more than one answer (Table 10);
- Improvement suggestions for the next workshops (Table 11).

Table 10. Evaluation of the workshop by the respondent participants - what they liked more and less.

Topics evaluated	Answers (in relation to who answered)		Feedback from FCT NOVA
	N.º	%	
What you liked more			
Structure and organization.	25	69,4	– Maintain/reinforce in the next workshops, especially in the structure/organization, contents/utility, but also in what regards the participatory activities, although fulfilling the approved in the project, the previously agreed with the municipal representatives of the project, and the established programme.
Utility.	19	52,8	
Contents.	18	50,0	
Participatory activities.	11	30,6	
Rhythm/dynamics.	9	25,0	
What you liked less			
Rhythm/dynamics.	7	19,4	– It is recognized that, in online activities (due to Covid-19 pandemic restrictions), the rhythm/dynamics and the participatory actions (and the contents/utility, in consequence) are compromised, so FCT NOVA will try to improve these aspects in the next workshops.
Participatory activities.	4	11,1	
Utility.	4	11,1	

Topics evaluated	Answers (in relation to who answered)		Feedback from FCT NOVA
	N.º	%	
Contents.	3	8,3	– At the beginning of the workshop, the project was presented, although succinctly; however, the project description was reinforced in a specific report (a summary, in Portuguese) about the results of the workshop that will be sent by the municipal representatives of the project to the participants.
Do not know the project.	1	2,8	

Table 11. Evaluation of the workshop by the respondent participants – improvement suggestions.

Improvement suggestions	Answers (in relation to who answered)		Feedback from FCT NOVA
	N.º	%	
Clarification about the project.	2	5,6	– At the beginning of the workshop, the project was presented, although succinctly; however, the project description was reinforced in a summary report about the results of the workshop that will be sent by the municipal representatives of the project to the participants.
Invite more construction companies.	1	2,8	– FCT NOVA asked the project municipal representatives to invite construction companies within their intervention area (until class 5 of construction permit title, to fulfil the objectives of the intended analysis); – Although each municipality opted for the strategy it deemed most convenient, many companies declined the invitation, others showed interest but later did not attend the workshop, and others not even responded; – In this context, FCT NOVA believes it is important that construction companies that have engaged in this workshop help to captivate other companies to participate in the next workshops that will follow.
More workshops because the information is very useful.	1	2,8	– Three workshops are planned within the scope of the project, and two more to be held on August of 2021 and January of 2022 (see chapter 1 – Introduction).
Focus the workshop on other CDW, generated by other construction specialties (i.e., plumber, painter, electricity).	1	2,8	– FCT NOVA recognizes the focus of the workshop on the CDW mineral fraction (*e.g.,* concrete, bricks, tiles), as this is the one identified with the greatest potential for recycling, but it takes note of the suggestion for improvement, which will try to ensure in the workshops that follow, involving other realities underlying by the participants.
More time for debate.	1	2,8	– FCT NOVA recognizes that, online, with inherent difficulties in time management, the debate is compromised, so will try to improve this aspect in the

Improvement suggestions	Answers (in relation to who answered)		Feedback from FCT NOVA
	N.º	%	
			next workshops (in a face-to-face model, if everything goes as planned); – Anyway, the workshop programme was discussed with the project municipal representatives, with the general idea that more prolonged actions would not be feasible due to the availability of construction companies.

5. Conclusions

Within the scope of the (De)construct for Circular Economy project, more precisely WP 7 (information, awareness and training), this report presents the results of the participatory workshop (Session A), held online on April 28th of 2021, entitled "Construction and demolition waste management by *Baixo Alentejo* construction companies – constraints, solutions and training needs".

On the participatory activities carried out with *Baixo Alentejo* construction companies, the following **main conclusions** stand out:

- Forty-one representatives of micro and small construction companies participated, from 10 municipalities (considering the headquarters registration), up to class 5 of construction permit titles, but with prevalence of permit classes 1 and 2 (51%);
- Regarding the reflection concerning the behaviour of construction companies about CDW management, the following is highlighted, in a very summary and merely illustrative way:
    - In the planning phase: the opportunity to continuously training the workers regarding CDW generation estimation and the respective management costs (to be included in budgets);
    - For CDW sorting and storage on construction sites: the recognition of a close relationship with the supervisors, who can be understanding/permissive with CDW management irregular situations;
    - Regarding the reuse of construction materials and incorporation of recycled materials on construction site: a good part of the companies feels motivated to implement these practices;
    - Regarding CDW transport and final destinations: participating companies recognize that they abandon CDW less frequently and when it occurs is due to being unable to manage it on construction sites, in terms of necessary means and costs, but also mention that they recognize that there are few information and awareness campaigns that focus on the topic of CDW illegal dumping, and that, in general, society does not attribute great importance to these occurrences.
- In what regards to internal constraints about CDW management, construction companies highlighted limitations associated with the implementation of CDW management, including sorting, collection, storage, and transport to final destinations, and those related to information, awareness and training, including technical monitoring work;
- For external constraints, the most mentioned are related with CDW delivery to facilities from the municipalities with appropriate conditions for its management, the costs associated, as well as those related to the CDW delivery to waste management operators.
- For the solutions that the construction companies propose to be implemented by the municipalities in order to resolve or mitigate the constraints (internal and external) they identified, stands out the

creation of temporary storage sites in the municipalities to carry out CDW management (CDW with municipal management responsibility), but also to store construction materials, for its reuse;

- For training needs, the topic that have more consensus is related to CDW management at construction sites good practices, such as sorting, as well as the hazardous CDW management; on the other hand, caution must be taken in what regards the circular economy principles implementation in the construction sector, because those topics are at the bottom of the hierarchy for training needs, namely regarding the reuse of construction materials and the incorporation of recycled materials, such as for example recycled aggregates;
- In what regards the construction activity dynamics for micro and small companies, most of them carry out a proximity activity (in the municipalities of the companies' headquarters or in contiguous municipalities), but mainly focused on *Alentejo* region and *Baixo Alentejo* subregion.

As **next steps**, two more workshops are scheduled to be performed with *Baixo Alentejo* construction companies, and will occur until the beginning of 2022: one dedicated to the common legal framework for *Baixo Alentejo* region; the other in articulation with the proposed regional strategy for the application of the circular economy to the construction sector. In the next workshops, the project partners will be called upon to intervene more actively, contributing through content, or sharing experiences, to be agreed later.

Iceland Liechtenstein Norway grants

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ANEXO I – Images from the workshop with *Baixo Alentejo* construction companies