



## Introduction to Constructability and Constuctability Programmes

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### Introduction

Constructability is a project management technique for reviewing the whole construction process before commencing with project implementation. Constructability reviews will reduce or prevent design errors, delays, and over expenditure by identifying potential obstacles to construction.

A constructability programme refers to integrating engineering design, and executive knowledge and experience to better achieve project objectives. The main obstacles to its implementation include partial comprehension of construction requirements by designers, and resistance of owners to constructability due to extra cost. An effective constructability programme will begin during the planning phase and will continue to the end of construction.

Many of the problems related to constructability are due to a lack of communication among the owner's engineers or designers and the construction companies before starting the project. Architects, engineers and designers are not normally experts in construction methods. By integrating constructability in the design process in the early stages of the project, construction disputes will be reduced, and as a result, project delivery will be more secure.

This article focuses on the benefits of constructability, and implementation of a constructability programme in companies, at both corporate and project level.

### Constructability in perspective

The Construction Industry Institute (CII) released guidelines for constructability in 1986, in which constructability is defined as optimum use of construction knowledge and experience in planning, design, provisions and implementation to achieve project overall objectives (O'Connor, 2006). Various studies have been done to explain constructability and to resolve the obstacles to its implementation in the interim years.

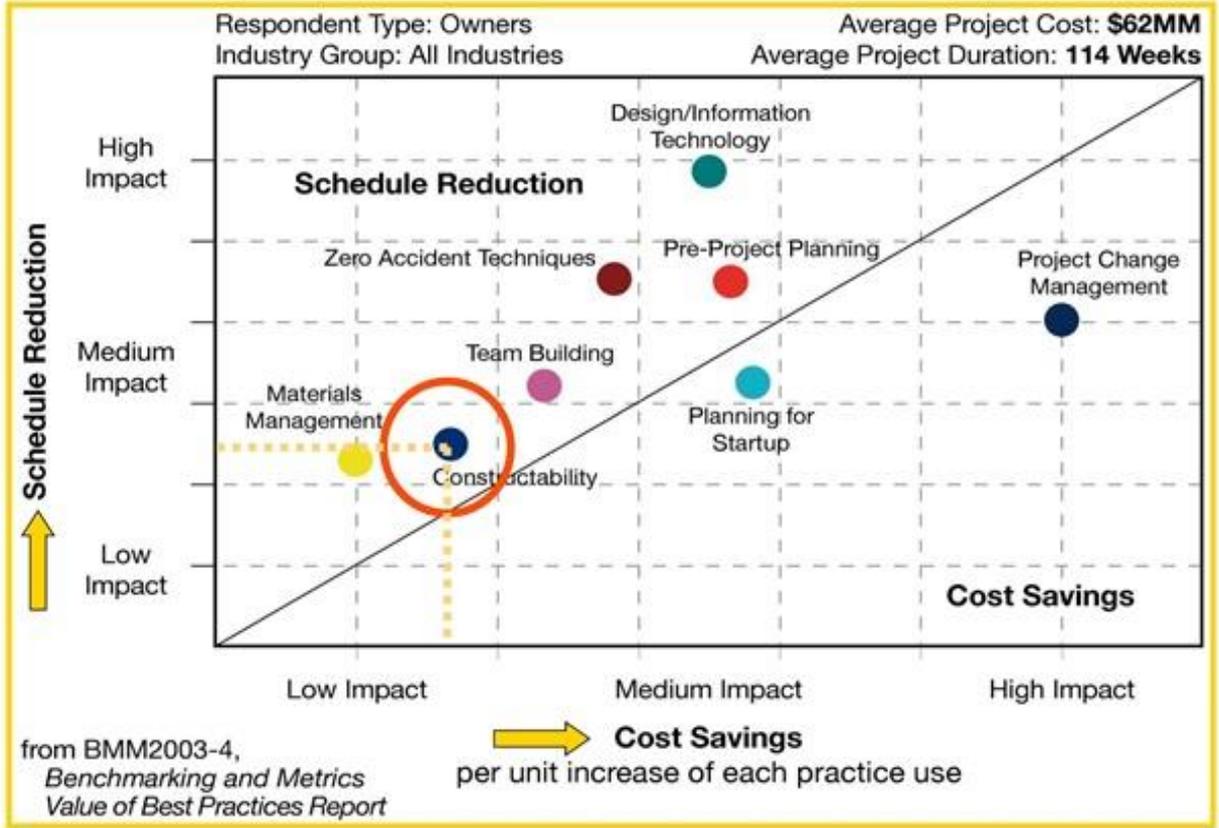
Improving constructability during project execution will thus improve the achievement of project objectives in the areas of cost, schedule, quality, safety, risk management,

and the impact on the environment. After completion of the project, the facility should also meet requirements in areas of reliability, maintainability and operability.

The definition of constructability implies that constructability should be considered from the planning (feasibility) phase of a project. Considering constructability during project development is only possible if it is owner driven, because the construction company is normally not yet on board.

Constructability during project development and implementation improves cost performance by 6,1% and schedule performance by 7,1%, according to the latest benchmarking done by CII (CII, 2019). In terms of value addition from constructability reviews, the cost benefit ratio is in the range of 1:10, additional cost of constructability: project benefit.

Figures 1 illustrates the benefit on project schedule and cost to the owner of applying constructability practices, in comparison to other practices.



**Figure 1: Owner benefit of practice use (Garcia, 2009)**

Figures 2 illustrates the benefit on project schedule and cost to the contractor of applying constructability practice. The perceived impact and benefits for contractors are much more significant than for owners.

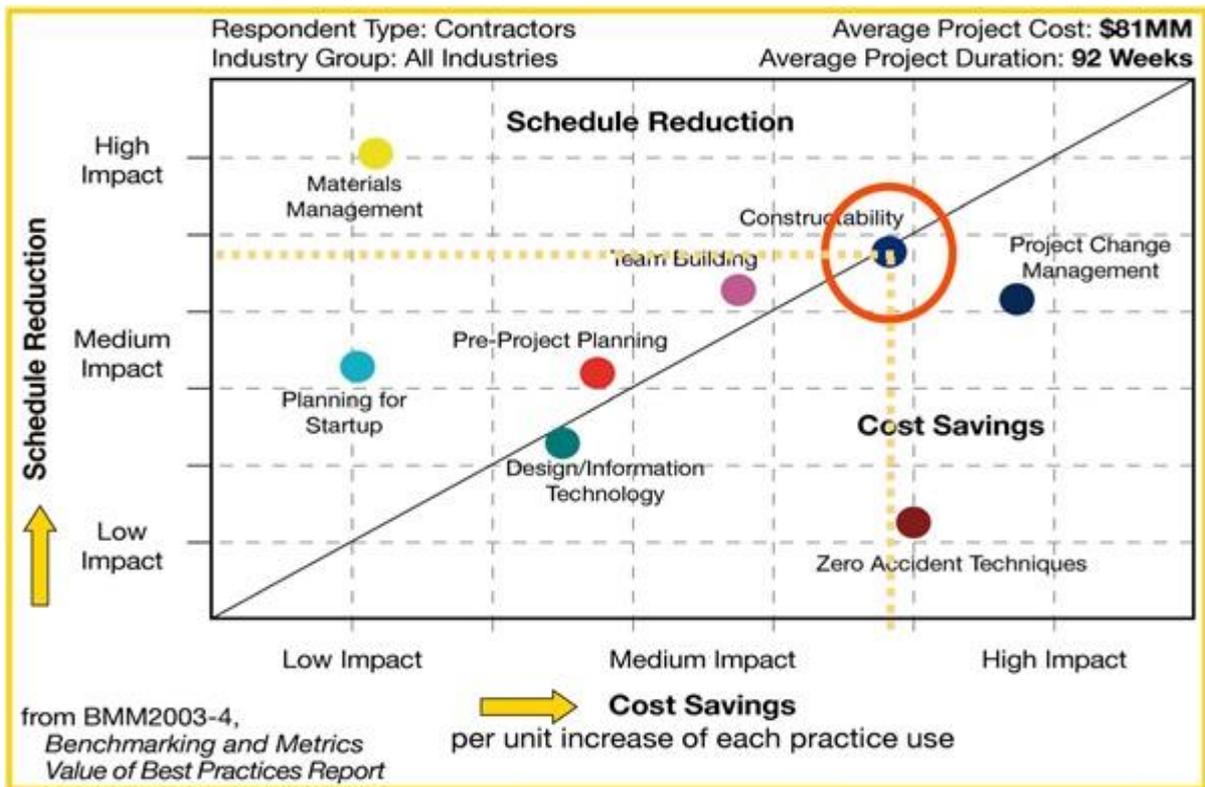


Figure 2: Contractor benefit of practice use (Garcia, 2009)

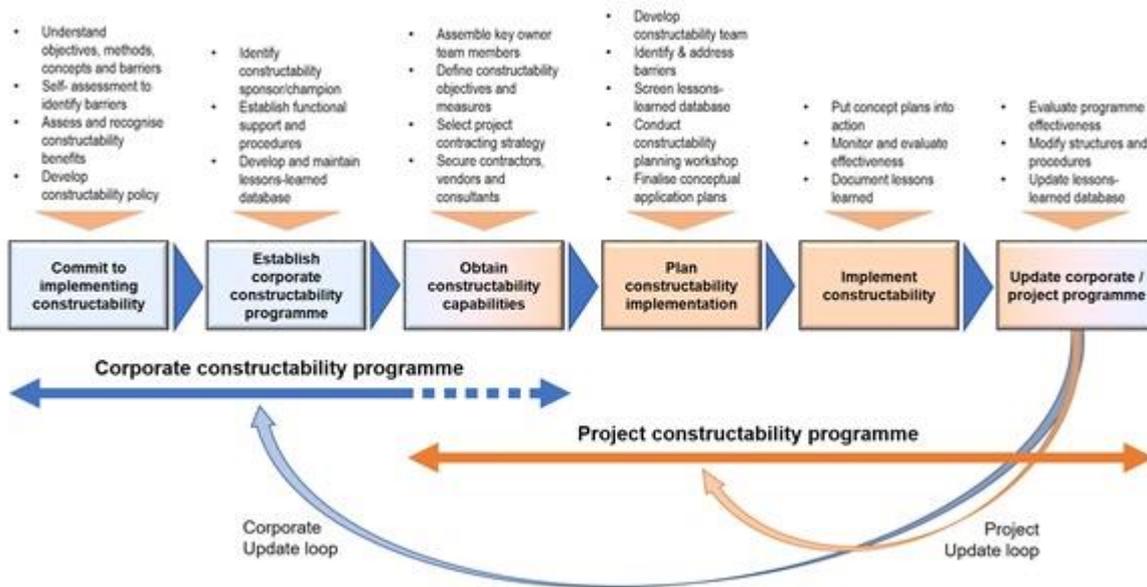
## Implementation of a constructability programme in an organisation

### Implementation roadmap

A company should ideally implement both corporate- and project constructability programmes. The CII developed an implementation roadmap, consisting of six stages as shown in Figure 3, which can be used by owners, designers and construction contractors.

The implementation covers constructability at a corporate level (the first two stages, with some overlap into the third stage), as well as at a project level (stages three to six). Stage six deals with the evaluation of the performance of the constructability programme which may result in changes being required at the corporate or the project level.

Each of these six stages of the implementation of a constructability programme is described in detail in the following sections. The bulleted lists above each of the stages in Figure 3 summarise the main elements of that stage.



**Figure 3: Constructability Implementation roadmap** (Adapted from O'Connor, 2006)

### Commit to implementing constructability

The existence of a formal constructability programme at corporate level, supported by a strategy and managed by an empowered sponsor, ensures that the infrastructure exists to support constructability programmes at project level.

All levels in the organisation should be aligned and have a good understanding of the model, objectives, methods and concepts of constructability. The alignment will be a top down approach and senior leaders should set the pace.

A self-assessment to determine the current in-house construction abilities and practices will be done and the outcome will be used to benchmark the current status (maturity) of constructability in the company. It will also help to define the programme objectives and improvement areas. The elimination of barriers that inhibit the implementation programme is of utmost importance. Barriers must be identified and eliminated by appropriate initiatives and programmes.

The benefits of a constructability programme should be assessed and goals (based on benefits of the programme) defined which focus the programme's implementation effort. Company targets, to be achieved at project level, can be summarised at corporate level to track progress and performance. Qualitative targets include improvements in team relationships, site layouts, budget- and schedule accuracy, as well as safety. Quantitative targets are reduction of overall project cost (say 7%), schedule improvement (say 8%) and a constructability cost benefit ratio of 1:10.

The last element is about the corporate profile of constructability, and involves the development of a Constructability Policy. The policy is signed by the president/CEO of the organisation and includes elements such as level of commitment by management,

name of corporate executive sponsor, programme goals for the organisation and a link to the implementation of constructability on project level. During the first year of implementation, reference should be made to the implementation programme, but constructability should be integrated with other programmes, and become part of “the way we do things” in the organisation.

### **Establish a corporate constructability programme**

The first element of this stage is to identify, appoint and empower a constructability sponsor that has the full support of the executive team. The sponsor is directly accountable for the success of the constructability programme.

The constructability programme on project level needs functional support and procedures. A programme manager role, that functions as a centre of excellence, is created to facilitate implementation of constructability at project level. The programme manager is responsible for day-to-day company-wide constructability coordination, selection and functioning of project constructability coordinators, functioning of a lessons-learned database and tracking of company programme goals.

The last element of this stage is the creation and maintenance of a constructability lessons-learned database. This database is of the utmost importance as it is used as an input during the “plan constructability implementation” phase in the project programme. The format of the database should facilitate retrieval for application to new projects, selecting areas such as discipline, functionality and project phase.

The implementation of constructability on a project has three logical steps, obtain constructability capabilities (supported and enabled by the corporate level programme), followed by planning for implementation, and implementation of the constructability programme.

### **Obtain constructability capabilities**

The owner project team members are pivotal to the success of constructability in the project, as they set the pace and drive successful completion. The (owner) project manager must be committed to constructability and be able to lead the team in 1) creation of a supportive project environment, 2) drive cost effectiveness 3) improve other project objectives by constructability and 4) ensure team involvement in construction. The rest of the owner team members will be selected on their work and construction experience, communication and teamwork skills, open mindedness and good evaluation skills.

The project team will define the project objectives in terms of cost, schedule and quality, as well as safety. It is also important to prioritise objectives, as it will improve decision making and potential trade-off studies. The project constructability objectives will be derived from the project objectives, with participation by design- and construction members.

The selection of the project contracting strategy impacts on the timing and application of constructability and affects the level of the formality of the constructability process.

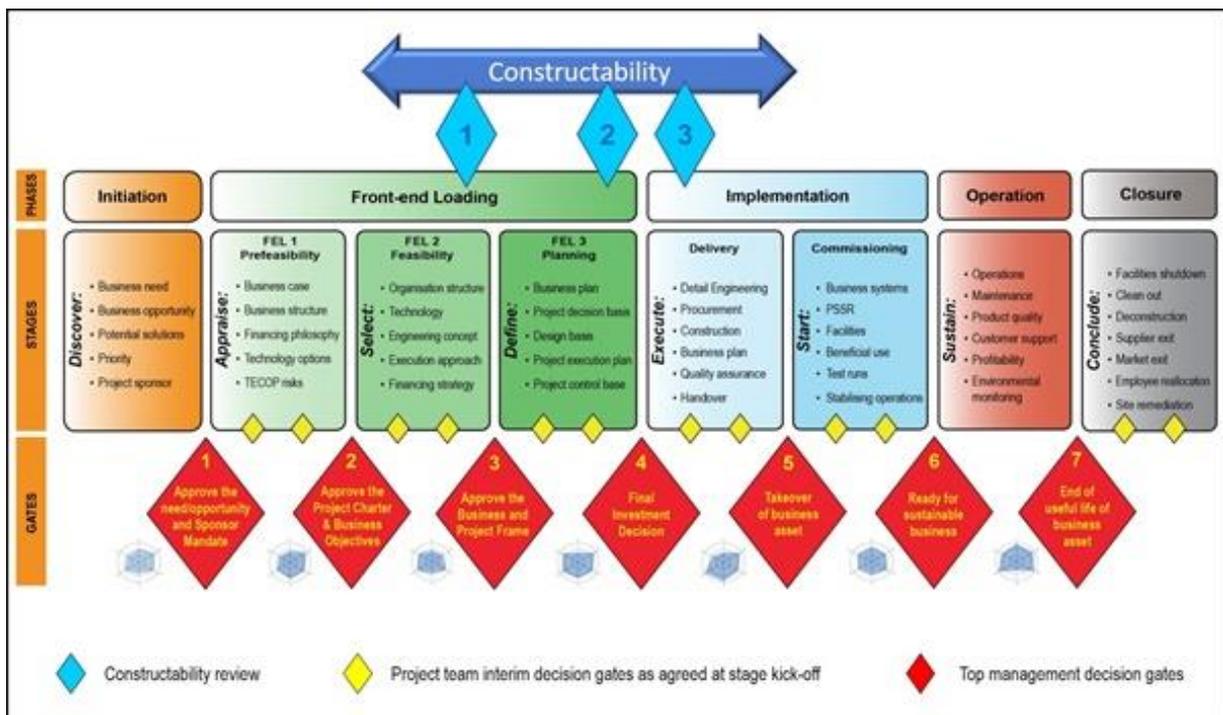
It is important that the owner, in selecting a contracting strategy:

- Assesses in-house constructability competence to lead or enhance the constructability process;
- Understands the impact of different contracting strategies on constructability; and
- Selects a construction contractor during the early stages of the project.

Owners can consider incentives which are related to constructability performance. It is important to incentivise designers and constructors for common deliverables such as quality and final completion. The incentives must be aligned to ensure that the two companies are dependent upon each other to be rewarded.

### Plan constructability Implementation

Timeous and thoughtful planning is very important to ensure effective constructability implementation. Constructability must start during the feasibility stage of a project lifecycle and continue through to the planning- and delivery stages. Three constructability reviews sessions are recommended, as illustrated in Figure 4.



**Figure 4: Duration of constructability and timing of constructability reviews**

The team members that will lead the constructability effort should have construction experience, be co-operative team players and be committed to the project schedule duration to minimise turnover.

The organisation structure of the constructability team will vary from project to project. All project team members participate on a part-time basis in the constructability team. The Constructability Coordinator may be a full-time position on big projects, but on smaller projects this role could be part-time and filled by the construction manager or other team members. The Constructability Coordinator reports to the owner Project Manager.

The Constructability Coordinator is responsible for:

- Orientation and team building of the entire project team;
- Integration of constructability into the project execution plan;
- Review of the constructability lessons-learned database;
- Assurance of adequate consideration of constructability concepts;
- Planning and scheduling of constructability studies;
- Gathering of constructability input from various ad hoc specialists;
- Maintenance of a constructability suggestion logbook;
- Evaluation and reporting on constructability progress;
- Solicitation of appropriate feedback; and
- Forwarding of new lessons learned to the corporate database.

Any constructability programme is more successful when the team is aligned and communicates openly. This need is addressed by a facilitated team building exercise where barriers are identified, and strategies implemented to break barriers.

Constructability teams can improve their effectiveness by reviewing lessons learnt from previous projects. The creation- and maintenance of such a database is discussed earlier in the article under *Establish a corporate constructability programme*.

The next step is to conduct the constructability planning workshop. The planning workshop will be scheduled after feasibility analysis. The focus of the workshop is to develop a plan for constructability implementation during project execution, list deliverables and compile a schedule for completion (aligned with project schedule) to support decision making (regarding constructability goals) during planning and delivery stages (refer to Figure 4).

CII identify 11 activities (O'Connor, 2006) that should be included in the agenda of a planning workshop. The purpose of the workshop is to identify constructability opportunities and concerns, prioritise constructability concepts to be implemented and the drafting of concept application plans for deliverables, required during the decision-making process to promote constructability.

Constructability activities (input) need to be planned for application during the different stages of the project. The Constructability Coordinator needs to integrate constructability activities and deliverables into the project schedule. It is important that constructability input is given during development of project deliverables and not at the review stage, as it will impose rework.

### **Implement constructability**

The constructability plan and initiatives will be integrated with the project work process as the project proceeds through the planning and delivery stages. Implementation will be executed in three steps: put concept application plans into action, monitor and evaluate implementation effectiveness and document lessons learned.

Concept application plans are key in implementation of concepts, but it is important to remember that the implementation is an iterative process during planning and detail design. (less so during construction).

Constructability concepts are high-level lessons learned. Inclusion in the project constructability manual stimulates the application thereof. If these concepts are compiled as check lists and arranged by planning activities or design disciplines, it can be put to good use during planning and review sessions.

Constructability team members provide constructability input and follow constructability procedures, detailed in the concept application plans, when required. The constructability effort is initiated during the feasibility stage and continued till the end of the delivery stage (refer Figure 4). The Constructability Coordinator is the main interface with the project team and is the focal point for overseeing and coordinating the constructability effort. The constructability team will meet on a regular basis to discuss concepts, share lessons learned and provide input to designs. Constructability reviews will be done by the constructability team on design packages before release, with the focus on confirming that approved concepts have been incorporated.

The Constructability Coordinator keeps a log of constructability suggestions and studies, and coordinates cost and schedule estimates for these suggestions. Feedback on constructability objectives may be made available at an agreed frequency to report on performance at project level. The performance of the constructability team is also monitored, and corrective actions implemented.

The final element under the implementation of constructability is the documentation of lessons learned. Feedback on the constructability programme performance needs to be documented as the project develops. Quality of design documents from contractors should be assessed. Lessons learned sessions should be conducted during all stages of the project, and summarised at the end of the project. It is also important to evaluate design aspects for inclusion in future projects.

## Update corporate/project programme

The effectiveness of the constructability programme at corporate level, as well as at project level should be evaluated to identify areas for improvement. The three focus areas are: evaluate programme effectiveness, modify organisation and procedures and update the lessons-learned database.

The review of constructability programme effectiveness should evaluate if the programme objectives and goals are met and if it should be revised or changed. A very important aspect is to review the level of support to the project level constructability programme, as the performance at project level is dependent on support from corporate level. The constructability barriers should be re-assessed, as well as the effectiveness of the barrier-breaker initiative. Successes at both the corporate and project level should be recognised, rewarded and announced at relevant levels. Recognition should also be given at the annual company reward ceremony (when due).

The company and programme organisation structure should be evaluated for effectiveness and adjusted/modified, if needed, via update loops (refer Figure 3). Rotation of incumbents should also be considered and updating of the succession plan for these positions. The effectiveness of procedures and tools used for training, communication, reviews and evaluation should be reviewed and adjusted as required, with focus on communication of lessons learned at project and inter project level.

Updating the lessons-learned database may be the last step in the constructability programme, but is one of the most important activities. The database should be updated with lessons learned from every project. New contributors should be identified and added to the system. The environment should be scanned for new or emerging constructability concepts on a continuous basis. Ensure that contributors always get constructive feedback and recognition for their contributions.

## Closing remarks

Constructability is not about adding more activities to an already overloaded project team, but a formalised process that sensitises and enables the team to start thinking about construction of the project as early as during the feasibility stage.

The project team is rewarded for utilising the constructability programme with a reduction in construction cost, direct field labour hours, construction schedule and design rework hours. The project team further benefits from improvements in lost time incident rate, ease of personnel and material accessibility during construction and maintenance, labour productivity, improved security and, improved teamwork.

Owner benefits will include reliability, maintainability and operability.

## References

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