Adopting the agile approach

How can a complex industrial project, which carries a high degree of uncertainty, be managed more effectively? The implementation of a greenfield cement project in India in just 13 months from ground-breaking to commissioning using the Agile Project Management (APM) method serves as an example of the effectiveness of this approach.

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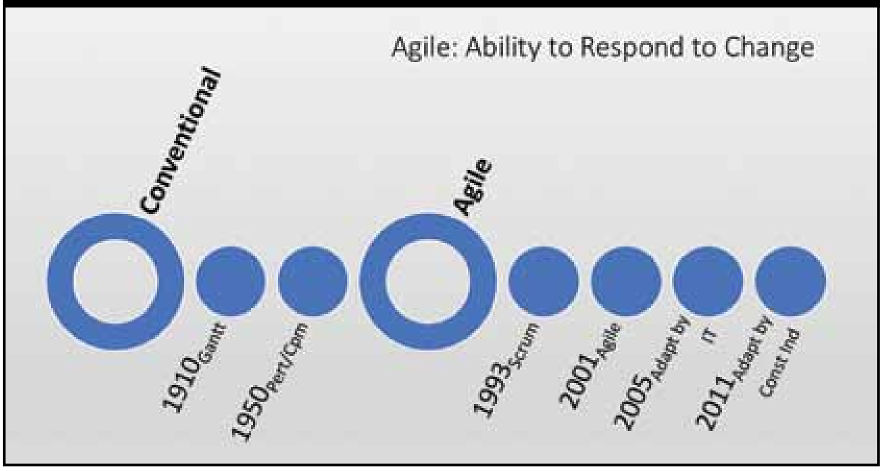
Agile Project Management (APM) emerged in the IT industry and has been successfully adopted in the design phase of construction projects since 2011. Applying APM in such projects has proved to be an effective technique for managing change compared to the age-old practices of Gantt and Pert (see Figure 1). The conventional waterfall method of project management, as depicted by colourful Gantt charts, is considered the traditional way to achieve control and predictability of a construction project. However, this approach became limited as increasing emphasis was put on risk management and timely project delivery. This saw the emergence of new techniques that put a greater emphasis on value creation for the client (see Figure 2).

The idea behind APM is to assign the highest priority to satisfying the customer through early and continuous delivery of customer-recognisable value rather than focus on different work elements in a construction project.

Figure 1: timeline of project management methodologies



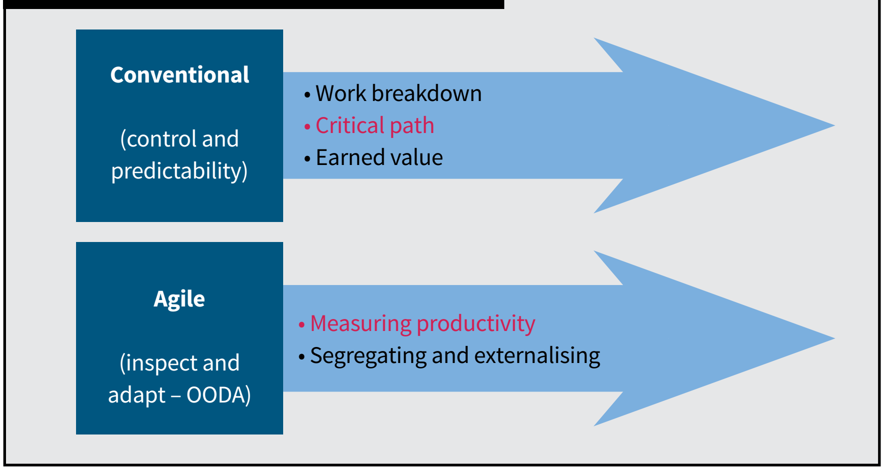
APM in construction

Uncertainties, both in terms of complexity and predictability, are inherent to an industrial construction project (see box: "Sector study: construction timeline of cement industry projects in India 2006-16"). APM can provide an effective solution as central to this approach is the ability to manage change.

Traditional project management practices often fail to predict the future as they do not always recognise the unwanted changes that invariably occur during a construction project.

APM principles are particularly relevant to the construction phase of a "process industry" project such as a cement plant. Typically, the production line of this type of industrial plant will have a varying degree of operational flexibility. These, when segregated during the construction phase, can provide value to a customer at an early stage (by being on-stream earlier) rather than having to wait for the completion of the project.

Figure 2: conventional vs Agile Project Management



Case study: greenfield cement plant in India

In 2016 Holtec was appointed by a cement producer to provide project monitoring and control services for building a new 2Mta greenfield cement grinding plant to be up and running from ground-breaking within 12 months, significantly faster than the industry average of 18 months. Adopting APM was instrumental in completing the project from ground-breaking to commissioning in just 13 months.

The first step involved situation analysis, assessing the project's specific variables and computed project implementation difficulty (PID) score (see Table 1). A consolidated master plan, following conventional methodology, was then prepared by assimilating schedules for different elements of the construction

Table 1: project implementation difficulty score (comparative)				
No	**Factor**	**Industry average**	**Industry best**	**This project**
1	Intrinsic	8.00	8.00	10.00
2	Internal	6.60	4.50	7.40
3	External	6.00	4.00	6.00
4	Project	6.00	4.00	7.10
5	Site	6.60	5.00	8.80
PID score (scale 10)		*6.63*	*5.08*	*8.15*
Overrun (base 18 months)		+6 months	0	?
Factor		**Variables**		
Intrinsic		Plant capacity (construction work volume), project type (greenfield, brownfield, upgrade)		
Internal		Contract management mode (package, procurement), project organisation (expertise in technological aspects, project implementation, procurement, speed of decision making), project management methodology (conventional, agile)		
External		Engineering team (external/internal), suppliers, contractors		
Project		Fully mature (or not) in terms of design, status of geotechnical studies, procurement, detailed engineering and financial closure (at time of awarding the construction contract)		
Site		Cultural diversity and skill levels of labour pool, influence of local political and religious considerations, extent of subcontracting and/or reliance on deployment of casual workforce, location-specific socio-political environment, site-specific metrological sensitivity		

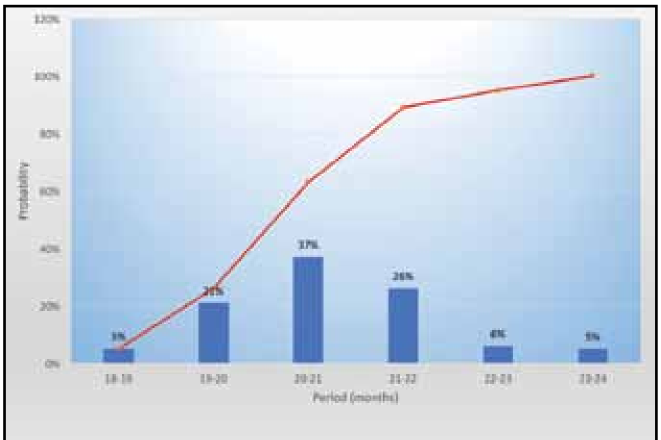


Figure 3: Monte Carlo simulation (project implementation - total work)

work, as provided by engineers, suppliers and contractors. The project timeline at this stage was worked out to be 18 months, excluding railway siding-related activities.

The master plan was then adjusted to take into account the PID score. Thereafter, a Monte Carlo simulation was applied to the adjusted plan to assess the impact of variability on the different activities of the project during the construction phase. According to the Monte Carlo simulation, the most realistic timeline was 21-23 months with a 95 per cent probability (see Figure 3). It was clear the emerging scenario was completely different from the owners' aspirations of 12 months. Therefore, it became imperative to adopt a different methodology for project management than the conventional method (see Figure 4).

A new way forward was formulated using APM with 'scope' considered to be a variable element, while 'resource' and

Figure 4: the way forward

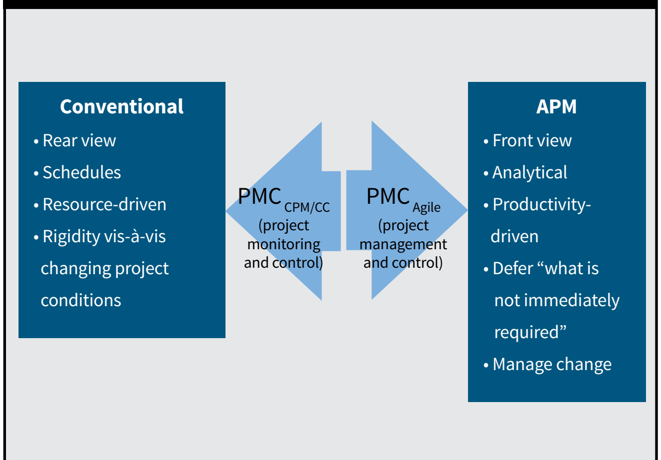
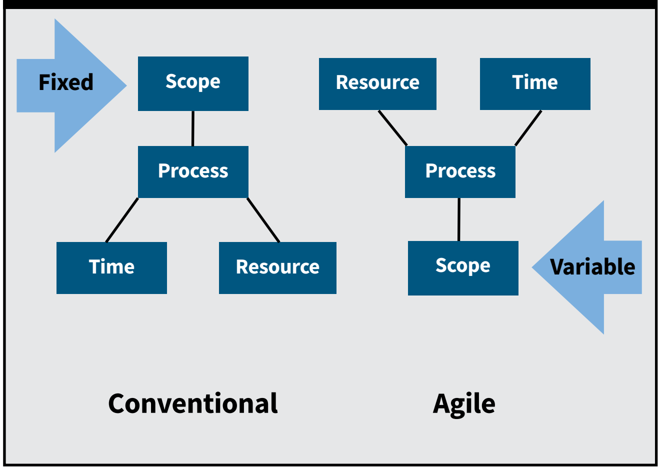


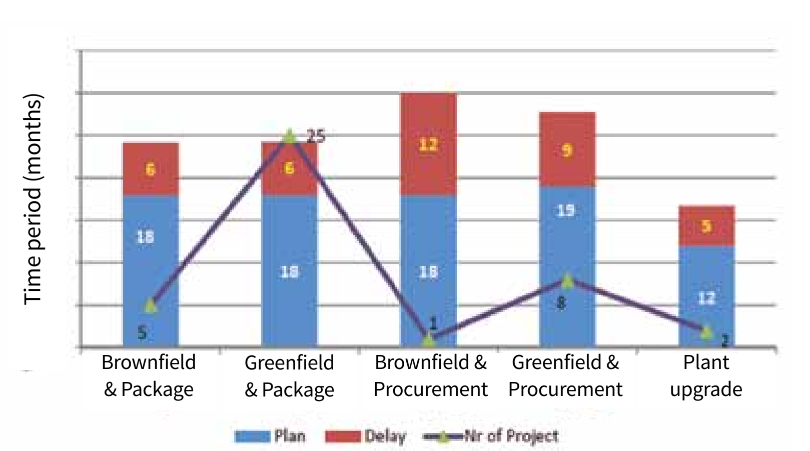
Figure 5: guiding principle (APM)



Sector study: construction timeline of cement industry projects in India (2006-16)

Holtec undertook an in-depth analysis of 65 cement projects constructed in India between 2006-16 to analyse various factors and their impact on the construction timeline for a cement project. Of these projects, 41 were considered for detailed analysis with a degree of data confidence above 85 per cent. The findings of the study are shown in Figure A.

Figure A: an historical perspective –implementation timeline for cement plant projects in India, 2006-16



For the detailed analysis, factors impacting the project timeline were developed using the factor analysis technique, starting with data on observable project variables as shown in Table 1.

Through factor analysis, factor loading(s) were found. These factor loadings were then corroborated with the help of regression analysis. For this regression analysis, weights were derived heuristically – by assigning varying weights to factors under different scenarios. The objective was to ensure a sufficiently-high coefficient of correlation between factors and the project implementation timeline (as observed for the 41 projects considered for detailed analysis). It was found that the factor loadings emerging from factor analysis were largely in line with those worked out using regression analysis when checked against the values in the trial run that gave the highest coefficient of correlation. Factor loading and computed correlation coefficient is shown in Table A.

Table A: factor loading and correlation coefficient

No	Factor	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
1	Intrinsic (%)	20	20	20	15	15	15
2	Internal (%)	20	10	15	15	20	15
3	External (%)	20	10	15	10	10	10
4	Project (%)	20	30	25	25	20	20
5	Site (%)	20	30	25	35	35	40
Coefficient of correlation		*0.7645*	*0.7983*	*0.7827*	*0.7920*	*0.8152*	*0.8252*

The next step was to compute a project-specific project implementation difficulty (PID) score by scoring the project-specific variables on a 10-point scale and assigning weights to each factor (as shown in Table 1). While PID scores provide a significant indication for preparing realistic schedules, they do not ensure a timely completion of the project.

Almost all projects adopted conventional project management methodology using MS Project/Primavera platforms. Unanimous feedback from project participants was that while past experience is valuable, it is not a reliable guide to future performance as it does not take project uncertainties into account. Such uncertainties, which result from the varying perspectives of the project participants and are summarised in Table B (see next page), inadvertently call for unwanted changes in a construction project and effective management of these could be the key to successful project management.

Table B: factors leading to project uncertainty	
Factor	**Element of project uncertainty**
Work force	High degree of labour intensity, low professional qualifications, low commitment level, low salaries, high cultural diversity, significant influence of local political and religious consideration. In addition, greater reliance on sub-contractors and casual workforce eventually acts as a significant impediment in receiving loyalty from the workforce.
Contractor's perspective	Risk avoidance is often paramount. Associated risk includes direct financial loss, cash flow mismatch and timeline default. To mitigate these (risks), contractors align their actions which have been observed to be in-variance with project requirements, eventually leading to blame-game tactics. They tend to benefit from a fragmented engineering process, particularly if the project is not fully mature in terms of design when the construction contract is awarded.
Ambiguities (known/unknown)	Factors such as weather, change in orders, labour quality, physical space, material flow, trade interferences and absenteeism.

Table 2: construction work volume

No	Work element	Total	Essentially required	Share of total (%)
1	Civil works (RCC)	45,368m^3	30,085m^3	66
2	Structural steel works	3529t	2343t	66
3	Equipment erection	4581t	3134t	68
4	Plate works	672	506	75
Share of work (%)		100		69

'time' were fixed (see Figure 5). However, this scope variability must not compromise on safety during construction and fully comply with the operational requirements of the plant such as automated plant control, product quality, productivity, and statutory and environmental regulations.

In this project, the plant systems were engineered to produce three different products – OPC, PPC and PSC.

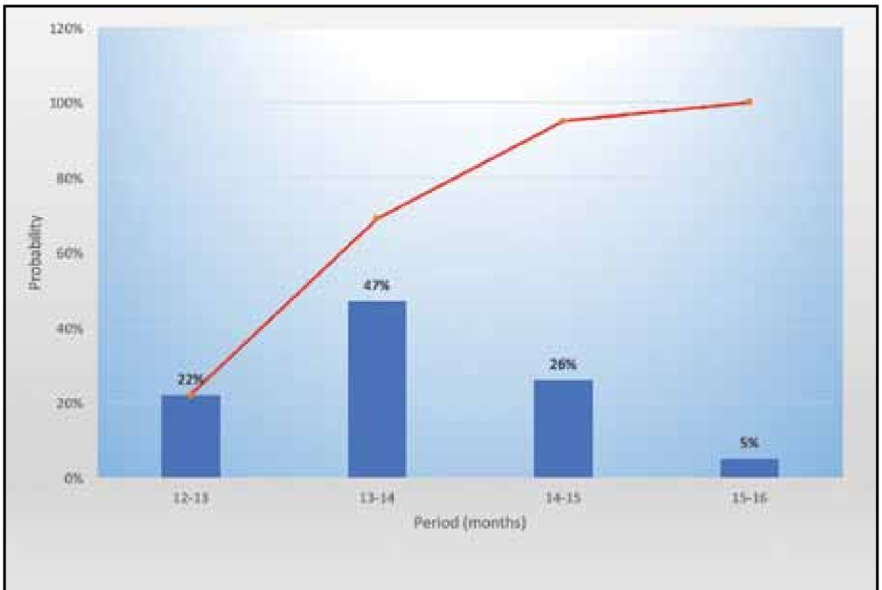


Figure 6: Monte Carlo simulation (project implementation – redefined work)

In addition, two technological processes were incorporated for inter-grinding and separate grinding (for PSC production). By segregating the construction work volumes for the three product types and two process solutions, it was found that commercial operations at the plant could commence when just 69 per cent of the construction work was completed, without compromising on safety and in full compliance with operational requirements (see Table 2). This made it feasible to deliver recognisable customer value within 13 months from the start of construction while being in sync with historically-observed data (18 months x 69 per cent).

The next step was to establish an achievable project timeline by factoring in the project's specific PID score and conducting a Monte Carlo simulation for the redefined work volume. By doing so this gave a new realistic timeline of 13-15 months with a 95 per cent probability (see Figure 6).

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Figure 7: decisive interventions

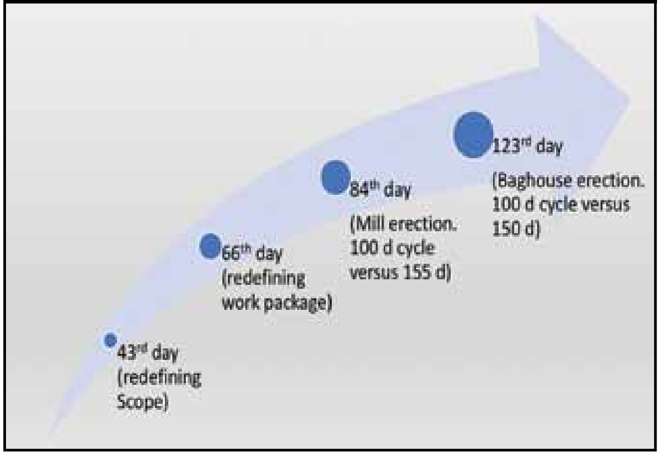


Figure 8: monitoring (conventional vs analytical)

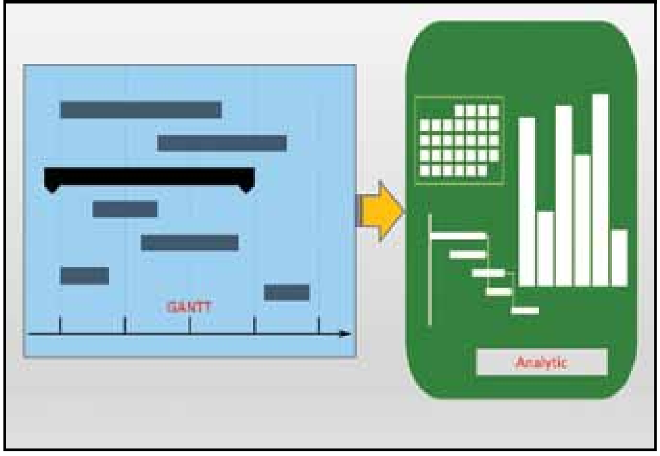
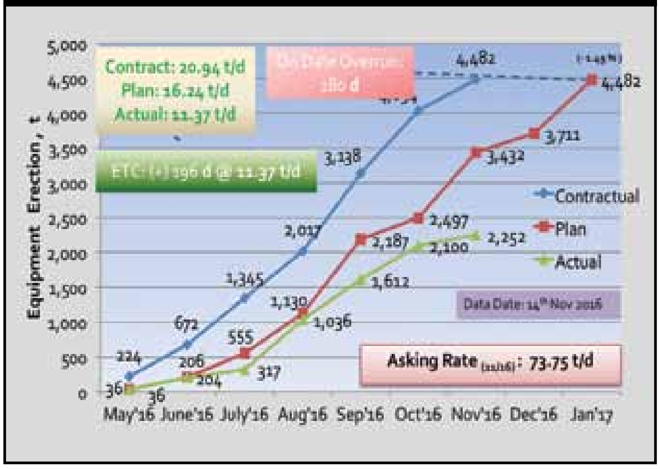


Figure 9: progress analysis (civil works)

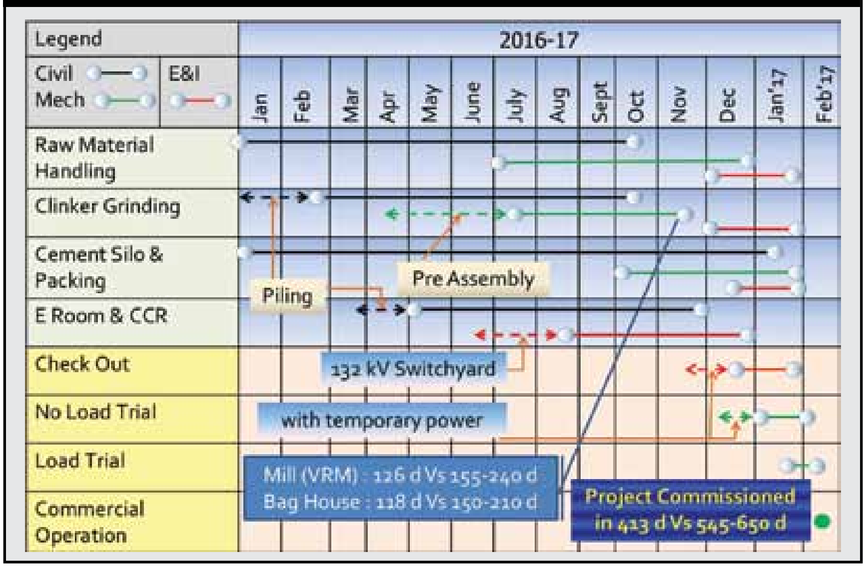
Figure 10: progress analysis (erection works)



To improve on this probability, a two-pronged strategy was adopted to optimise the critical path activities – in this case the erection of the mill and the baghouse - and adopt the observe-orient-decide-act (OODA) technique for project management on a fortnightly basis rather than monthly.

Decisive interventions for optimising the critical path activities were undertaken (see Figure 7). Project monitoring relied on Holtec's construction data analytics while the Primavera base schedule was used to assess the impact on the timeline, both of 'on date status of progress' and evolving 'backlog mitigating options'. Representative tools and OODA sheets (construction data analytics) are shown in Figures 8, 9 and 10.

Figure 11: project time line following adoption of new project management method



Conclusion

Using agile tools and methodologies resulted in the project meeting its objective of an early start of revenue line for the customer, on schedule (see Figure 11). The integrated team approach, coupled with a common, shared and communicated vision and goals, led not only to higher-than-average productivity but also practical measures for eliminating inter-trade barriers and keeping the project focussed.

While there was no formal discussion or implementation of an agile approach, the project was conducted following the APM principles with daily meetings and fortnightly monitoring of progress. In conclusion, APM methodology can provide real benefits in enhancing the effectiveness of project management during the construction phase of an industrial project when applied in conjunction with domain expertise. ■