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**Article**

## Study On The Multi-Project Management Practices for Complex Investments

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# STUDY ON THE MULTI-PROJECT MANAGEMENT PRACTICES FOR COMPLEX INVESTMENTS

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## Abstract

This paper highlights the results of a study carried out during the doctoral research in case of multi project Engineering, Procurement, Construction, Commissioning (EPCC) investment types. The objective of this study was to improve the project portfolio management. The methodology used in the research presented in this paper is focused on the analysis of the authors related to the approaches debated in literature and their applicability in EPCC type investment programs. In this sense were analyzed 11 international projects in petrochemical and refinery field and also 7 investments in other different areas of chemical industry.

The research highlighted that the management process of these investments can be improved through the correct project integration, being able to provide a performing working environment able to sustain the management team in identifying the investment program criticalities and congestion points in order to be able to manage them in an efficient manner in order to assure the reach of the investment goal. Having as consequence the possibility to significant reduction of execution period, up to 16% and in the mean time also the delays related risks through a more efficient investment managerial act.

## Keywords

Multi Project Portfolio Management, Efficiency of Portofolio Management, Critical Path, Integrated Master Schedule

## JEL Classification

M1

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## Introduction

In the current economic context, new tendencies in investments field were identified, as reaction to the condensed increased demand of standardized products on the global market (Sandru et al., 2014). So, for covering this condensed demand, it was build the frame for developing mega projects, from energetic field and industrial construction works. (Killen et al., 2012).

Projects shall not be seen as individual entities. In present business environment, effective management of the entire project portfolio has become mandatory for achieving the expected performance targets. The most important phase in project portfolio management is the front end of projects with focus on business analysis and studies. This is in particular most important by its capability to generate new opportunities, ideas and strategies and so the basis for later project, portfolio and corporate success is set (Heising, 2012).

According to Kaiser et al. (2015) project portfolio management represents also a commonly employed technique to align a project portfolio with strategic goals.

Project management processes are in direct correlation with organizational environment, therefore the forming training and coaching of the new project managers shall take in consideration the potential effect of organizational change on the successfully completion of the projects (Hornstein, 2015).

Mega projects by them size and complexity changed the paradigm in managing them. It is not possible to manage such project as a single project. Therefore, there were developed management tools and instruments able to offer the capability to manage the entire portfolio of projects grouped in an investment program by not losing the advantages offered by a centralized model. The stake is significant; it is common for such investments programs to overpass in energy field budgets of over 10 billion USD.

Project risk management is important and certainly lead to project success. It should be noted that current risk management tools do not have such a predictive ability to indicate any potential risks that may appear before starting a project (Yim et al., 2015).

Following these, a new tendency was identified in such projects due to the fact that the project owner wants to involve himself in managing the investment program for obtaining a maximum benefit. Classical contract approach with a general contractor on a lump sum contract starts to be overdue by new contracting approach on reimbursable typology contracts managed by project owner team (Sandru et al., 2014).

This means that the possible low performance risks but also the potential benefits that can result are targeted by the project owner team. The project management principles are in their essence the same in case of portfolios or individual projects (Schwindt and Zimmermann, 2015). These reflect in the necessity of continuous adjustments according to the organizations goals for building a rigorous management system taking into account all disciplines driven projects from the portfolio in order to optimize their results by an efficient progress monitoring and resources management (Cleland and Gareis, 2006).

## 1. Current approaches in gaining portfolio management efficiency

Given the growing number of projects in a company, it is very important for the efficient administration and management of these to be structured in a project portfolio for the

effectively strategic alignment. In terms of project portfolios with product delivery and customer service, these involve a strong connection between a project portfolio management and increased customer focus (Voss, 2012).

There must exist to the organization level a clear connection between outputs created by the project and the company's business strategy in order to create optimal value of the investment in projects (Weaver and Too, 2014). The purpose of EPCC investment program type is complex. Thus it can be structured in 4 main phases driven from the disciplines: Engineering, Procurement, Construction and Commissioning.

As response to the concurrent market, the contractors are forced to specialized themselves in certain phases and disciplines, contractors with overall skills mainly they are competitive in none. As follow in order to cover the entire investment program scope, the contractor shall contract services by phase and discipline (O'Brien and Plotnick, 2010). I.E for engineering, construction and even commissioning part, we will have different contractors specialized in different areas such as civil works, piping, steel structures, electrical works etc. The procurement part is mainly and usually covered by the project owner team due to the significant number of variables by having the overall scope grouped by phases and disciplines with its own specialized contractors, with individual contractual scopes and schedules the project management team is mainly focused on present phase activities considering in a mistaken way that the overlaps are insignificant and not relevant for the overall investment program.

For an optimized integrated approach focused on the earliest possible start of each phase and on the efficient linear assignment of resources it is needed the support of modern technologies capable to calculate and summarize the information's produced by the new integrated management approach (Olaru et al., 2014).

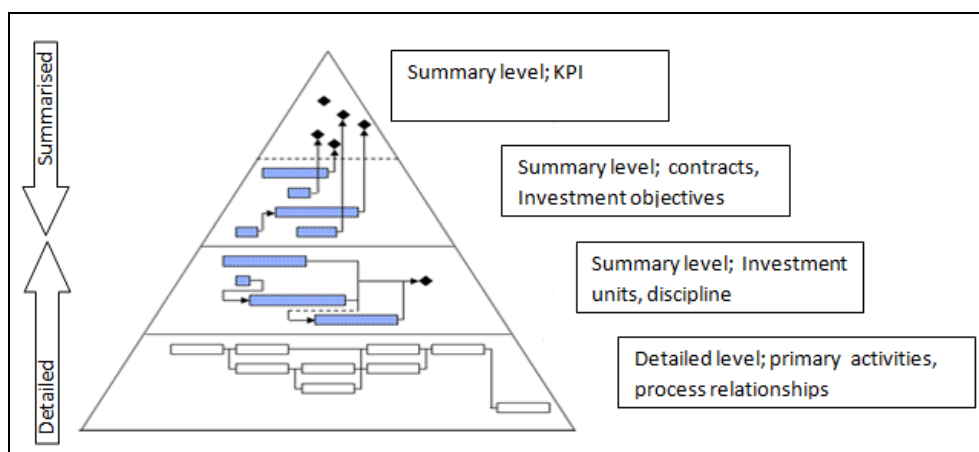


Fig. no. 1. Integrated approach of project portfolios

The portfolio management is facilitated in a integrated approach at discipline level trough the logical relations between partial completion milestones. So, there are avoided the lost times to completion of the Scope of Works (SOW) at the discipline level. Through the logical, process

driven relationships between the investment portfolio activities, starting from the last commissioning activities, without taking into consideration other criteria's (discipline; contractor etc.), it will result the integration of the entire portfolio and thus the optimisation of the schedule, the single constraints being the process resulted ones. Following this approach, the local, project level priorities, being set on secondary level of importance, the focus being set on the portfolio level KPI's. Then after through several stages of summarizations, being obtained the summaries schedule at discipline, contractors, units, investments objectives, etc. level. (Figure no. 1)

An investment program is actually at a macro level comparable with a unitary project. The single difference consist that a unitary single project may be treated as an overall by being defined through its own activities assigned to the unique Work Breakdown Structure (WBS). In the same way at a portfolio level, the individual projects, shall be treated as investments chapters, WBS structures, in order to achieve the completion objectives (Lewis, 2002).

So, it naturally appears the question: When should we, as project owner team start to integrate the investment projects?

In the common practice as evidenced through this research the project owner team starts the integration process in the construction phase. This approach is not the optimum one. The process of integration the investment frame, shall be started at the earliest moment possible of the investment program. For doing that the investment scope shall be complete and clear defined (Sandru and Olaru, 2013).

The next step is to develop the work strategy and roles. In this stage it should be agreed the working methodology. It shall be defined if it will be used a general contractor or not and how will be split the overall scope of works. Following those two initial steps the entire project owner team will be build, in order to manage the portfolio according to established strategy. In what concerns portfolio of projects it requires more than integration of the individual projects to obtain maximum performance.

Each project has its part, both constraints and their own performance indicators. The management team shall be continuously in the position to coordinate those to obtain an optimal at the overall portfolio level (Sandru et al., 2014).

Therefore integrated summarized analysis is needed for support to overall critical path analysis, overall S-Curves and progress analysis and overall Earned Value and performance analysis. Those tools are needed by the management team for assuring the reach of performance targets.

## **2. Research methodology applied for analyzing and defining the portfolio management frame**

In the period 2013 – 2014 were analyzed a number of 11 investment, international projects in the petrochemical and refinery field, as well as 7 investment projects from different industrial chemical field. The analysed projects are major international projects; 2 projects related to the building of a new refinery, and the modernisation of a existing one in Kingdom of Saudi Arabia, 1 project related to water desalinisation in Qatar, 2 Turn around and modernisation projects o refineries in Romania; 2 refineries modernization projects in Germany, 3 refineries modernisation projects in Belgium; 2 petrochemical installations

modernisation projects in Holland; 1 Turn around and modernisation projects o refinery in Austria; 2 modernisation of gas desulphuring units related projects in Romania; 3 modernization of chemical installations in Italy.

It was targeted the improvement of the projects portfolio management, by identifying the approaches related to the integrated project management, in order to define adapted to the specific requirements of models, management methodologies and tools.

Following these, several research activities were fulfilled:

- documenting referring to multi project management, progress measurements, performance analysis, critical paths analysis, extension of time claims procedures;
- consulting active contractors during the coordination meetings focusing on project controlling and performance analysis on questionnaire-based support
- practical implement of customized tools in different project portfolio, EPCC investment program types as member of the management team and evaluation of these effects.
- developing and implementing of work procedures, reporting templates and statistical evaluation of the results following these actions.

During this research were organized 52 audit meetings with the employers and contractors executive management team. Were developed and send 265 specific analysis questionnaires, to all involved in the management team, on employers and contractors side. Were received 136 completed forms. Were developed and implemented 52 specific procedures for the improvement of the integrated project management.

The analysis forms and questionnaires were structured on the following sections:

- General information's related to the organisation; structure; work points (prefabrication workshops; sites etc.)
- Specific information's related to project management.
  - ✓ Preparation – (prefeasibility studies, feasibility studies; SOW developing, approach strategies)
  - ✓ Planning – (Activities definition; activities relationships; resources assignments; activity level budgets; projects integrations)
  - ✓ Progress update (calculations and weightings of achieved progress)
  - ✓ Correction actions (Rebaselines)

For the evaluation of answers was used a five-level scale of assessment, from "at all" to "very much"/"completely"(if applicable), and some of the questions answered were two variants, namely affirmative or negative. In the second part of the questionnaires were requested narrative explanations.

The audit meetings were structured in the same approach with the forms and questioners and were oriented to clarify the analysed aspects.

Following the evaluations, were developed specific work procedures. The effect of these implementation were reanalysed in the same way.

### **3. Research results related to the applicability of management tools to improve the efficiency of multi – project portfolio management**

Due to the unique character of investment programs the project portfolios are very different. Therefore the management team shall adapt and develop for each individual investment portfolio specific and customizable tools in order to be able to optimize the chances to meet the performance completion targets.

Thus a satisfactory quality of the information and the reliability of these can be obtained only in a complete integrated and structured portfolio environment. Focusing at individually distinct projects is not a correct approach in what concerns the investment program success. What matter are the overall indicators toward portfolio. Success or in success in project level, high priority areas may have not any impact or a minor impact towards the entire investment program.

#### **3.1. Research results related to the approaches of investments integrated project management.**

Following the conducted research it was demonstrated that in order to be effective and to offer the necessary information for a performing management act the reports shall be in a summarized form but in the meantime to offer sufficient analyzed information. Because of the impressive volume of data the so named “Helicopter View” is desirable, but the information’s to feed these summarized reports shall be deeply and detailed analyzed at individual project level and further summarized at portfolio level. Following the above to be able to offer the needed overall information our research pointed several criteria that are needed related to the investment portfolio integrated schedule:

- to cover all the logic driven from the constructability reviews and start-up sequences – 68% of the analyzed projects have had major issues in defining the process logic.
- to include all the engineering, procurement, construction and commissioning events, accomplishments and tasks to project completion – 35% of the analyzed projects have no or incomplete milestones defined.
- build-in logic between the different component distinctive Schedules at activity (Milestones and/or Tasks) level; - 92% of the analyzed have had the component individual projects as stand alone or inadequate integrated.
- to contain measurable tasks by quantities and budgeted man- hours (MHRS); to facilitate the updates based on the data inputs from Contractors; - 43% of the analyzed projects have had no MHRS and/or budgeted quantities assigned.
- to be configurable and able to offer different levels of combined reports from timing quantities and MHRS perspective by lots, areas, contractors, disciplines, units, systems and subsystems; and by different interests areas – as we have stated above, 92% of the analyzed portfolios have had major integration issues, which block completely the development of combined reports.
- to be able to offer the information in different levels of summarization; - the integration deficiencies block the development of summarized reports.
- the names of accomplishments and tasks should be descriptive, concise and specific to the program. – 18% of the analyzed projects, contained activity names and milestones in alphanumeric format coded after own contractors rules, which made the management of these activities and milestones difficult.

### 3.2. Research results related to the development of project portfolio

#### 3.2.1. Stages and Phasing

The conducted research demonstrated that the optimization of the investment portfolio results can be achieved, only through a performing management act, in sense as the specific management activities to coordinate the distinct projects as integrated part of an investment program, with focus on overall completion milestones.

As per our study, a distinct contractor project can be defined as a micro-entity for the investment program. Thus the distinct project has its own micro entities, as WBS structures and activities.

Following to the audit meetings and work procedures implement evaluation resulted that, at local, at the distinct project level, there are also targets, milestones, Key Performance Indicators (KPI's) to be defined. In pursuit of managerial performance of portfolio investments programs a progress reporting technique using intermediate milestones to provide benchmarks to report progress against shall be developed.

In the process of portfolio investment programs management are required four distinct phases. (Fig. no.2):

- *Defining the scope of works* – Define the investment strategy, split the overall scope in components that can be individually managed and contracted;
- *Projects integration* – All projects shall be managed in a unitary approach, for focusing on the more important portfolio objectives than the local, project ones;
- *Portfolio analysis and progress measurement* – A unique progress measurement system shall be developed in order to offer reliable summarized data;
- *Portfolio optimization* – In case of slippage, the management team shall react promptly for keeping achievable the overall completion milestones.

Each of the four phases shall be treated and analyzed adequately. The first two are referring to the investment strategy, and therefore shall be treated with professionalism.

The errors in strategy are the most impacting, and the hardest to mitigate, referring to the overall performance results.

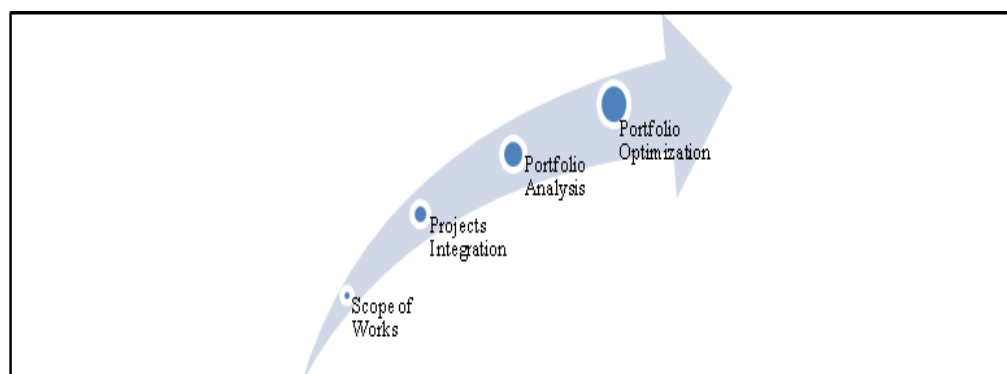


Fig. no. 2. Portfolio management phases

### 3.2.2. Defining and splitting of the Scope of Works

The conducted research pointed as evident, that in project portfolio execution strategy, the capital role of an explicit well defined SOW (Scope of Works). Although the well detailing of SOW is agreed as a high important prerequisite, which shall be completed in the earliest stage of a project, the execution strategy, through the split of the overall SOW is not fully taken in consideration in early phases by the management teams. Following our research it resulted that 92% of the analyzed project portfolios, have had major integration issues in construction phase. This conducted to severe impact in the overall execution performance of the projects.

It was clearly shown that for completing this stage it is mandatory to fully complete the prefeasibility and feasibility study, and also the Front-End Engineering Design (FEED) phase. During this phase shall be developed the Pre-Project Planning (PPP). The FEED is the first engineering module after the conceptual, feasibility study. It has as objective to define the technical requirements, and also the budget for the investment cost of the investment program. During this phase will be defined the contracting strategy, as well the bidding documentations for the EPCI (Contract Execution Phase). Our research concluded that in this phase additional actions are to be taken:

- develop the execution and contracting strategy;
- SOW split according to the execution strategy;
- develop a responsibility matrix and co-working procedures in the projects portfolio;
- develop the integrated progress measurements and reporting system at portfolio level.

### 3.2.3. Projects integration

Our research has pointed that in order to adequately manage the investment projects portfolio, it shall be defined in the bidding requirements documentation and later on in the contracts for each individual project defined during the FEED phase the complete methodology of project planning and progress reporting. This is to facilitate the later on integration process through logical links between the individual projects. The conducted research shown that the importance of this stage is often misevaluated in the starting of an investment program, driving often later on in the construction phase to severe difficulties in having overall investment analysis with focus on completion milestones and financial performance. Our research concluded that specific documentations and working procedures are to be developed such as:

- schedule requirement specifications, in order to coordinate all the contractors to manage their individual projects in such manner in which to permit a later on consolidation at portfolio level;
- reporting calendars, cut off dates and templates;
- resources and quantities measuring systems. I.E Piping quantities can be analyzed in tones or WDI (Welding Dia Inches).

Once the individual Schedules are standardized and the working procedures are in place, the integration process can debut. Our research clearly show that, in order to have a reliable projects integration at portfolio level, the integration process shall be focused in identifying the technological interdependencies between the elementary activities of different projects. It was observed that a back-to front integration starting from the last milestone to be

achieved at the end of the commissioning phase, and identifying the logical predecessor activity from the portfolio activities to be executed, is more accurate. The result of this consolidation will be an integrated portfolio, able to be analyzed as an entire. This is a multi iterative process, which continuously improves having as main focus the overall completion milestones.

#### **3.2.4. Portfolio Analysis and Progress Measurement**

Following our research, during the audit meetings resulted that during the Project Execution Phase, the project managers are focused in managing their individual projects based on the project management methods and techniques, but a local level project analysis, is not sufficient and even not completely relevant for the entire portfolio. Only an output of project integrations can be identified and properly managed the overall critical path which will focus on the critical activities and events for the entire portfolio. So, projects that appear before integration of secondary importance, from budgets point of view or other classification methods, can contain activities with no time float for the entire portfolio. In the same manner the progress measurement methodology shall be developed in order to offer reliable information based on weighted results. Every activity shall have an estimate man hours for the completion of the works, based in the representative quantity of the activity (m3 concrete, steel tons, etc) multiplied by a productivity. Based on these man hours, shall be calculated an activity relative weight inside every level of detail of each project, and by extension up to the investment program level.

#### **3.2.5. Portfolio Optimization**

The conducted research shown that once the investment frame was build through the integration processes, than can be settled up the investment program KPI's and the completion milestones. Based on the first iterations of integration measurements, can be observed that certain completion milestones, do not fit in the time frame as established in the feasibility phase. This is mainly, due to the fact, that the work packages are planned by the local project management team, based on the local priorities to fulfill the contract. It was evident that the vector for doing the portfolio optimization is mainly the last phases of the industrial investments, the commissioning and the start-up phase. The overall commissioning schedule is mainly system driven, and therefore it shall be linked with the completion dates of all subsystem parts, to be executed by the different contractors. The portfolio management team shall coordinate all the projects with focus on the overall KPI's. When slippages appear it shall come with corrective actions, settled up in overall rescheduling, by changing the strategies to optimize the chances to achieve the completion milestones.

The implementation of these concepts and methodologies, adapted to the specificity of the investment project portfolio, conducted to significant improvements in chances to reach the completion performance targets. These methodologies are very important for pointing to the management team the portfolio priorities and the overall status of the portfolio. Slightly delays on specific area at a project level can have major impact on completion milestone at portfolio level. Without a customized powerful portfolio management system, these delays can be overseen and observed in a very late status, when corrective actions are very hard to be taken and sometime even impossible.

### 3.2.6. Progress measurement and control

The conducted research shown that it is insufficient the contractor progress measurement for each individual project. It shall be defined a common progress measurement and reporting methodology for all projects of a portfolio and these shall be endorsed and approved by project owner management team.

The progress measurement applies individually to all of the investment phase:

- engineering;
- procurement and/or Subcontracting;
- construction;
- commissioning.

### 3.2.7. Planned progress

Following the audit meetings, part of the present research it was resulted that the progress monitoring shall be done at activity/deliverable level defined by the WBS Structure. To each activity / deliverable will be allocate a weight (eg. estimated man-hours associated). The progress of every deliverable will be expressed in percentages by using milestones that correspond to physical steps of the deliverable.

Our research indicated the fact that 92% of the investment programs have had project integration related issues resulting in miscalculation of the overall progress, planned and actual. The global planned progress shall be calculated by summing up the weighted progress of each deliverable. Planned Progress per analysis unit (project; discipline; unit; phase etc.) can also be calculated if necessary, in the same manner.

To retain a consistency in progress reporting, the weight factors shall not be modified, during the course of the investment program.

Another aspect pointed through the conducted research is the fact that in 68% of the analyzed projects of integrated portfolios, does not respect the same cut off dates (analysis dates). This means that, the reported progress, from the individual projects, is not related to the same time frame. It was shown the importance of unitary cut off dates, on which the obtained progress shall be calculated for all the individual projects. So, the actual progress shall be assessed by either one, or a combination of, the following methods, depending upon the nature of the activity concerned:

- from physical measurable quantities actually installed (partially or completely), in the case of most construction activities;
- according to deliverables and progress milestone scales specifically defined for each category of engineering and procurement activities. Progress scales shall be developed with reference to controllable milestones or stages in work achievement.

Actual progress shall not, under any circumstances, be assessed by reference to man-hours spent, being highlighted through our research that such method do not offer reliable information regarding the status of the investment program, having included in the progress figures also the low productivities and lost times.

Actual progress shall also be documented by contractor trough documents; approvals etc.

For activities of short duration, progress shall be taken as 0 % until completion which shall correspond to 100% of progress.

### **3.2.8. Progress report and progress revision**

The conducted research shown that, the planned and actual progress values shall be expressed through progress S-curves and progress tables for each individual project and consolidated in an overall portfolio S-curve as detailed below in this paper.

Integrate reporting is not feasible before correct project integration.

Beside the S-curves as an efficient progress measurement tool was pointed during our research also the different progress tables.

These shall indicate the following at individual project and discipline level:

- activity number/designation (listed as per the WBS);
- planned progress to date;
- actual progress to date;
- man-hours planned and expended;
- productivity factor to date.

The productivity factor is obtained by dividing the planned man-hours by the man-hours expended to achieve it:

- a factor smaller than 1 demonstrates a bad productivity;
- a factor higher than 1 demonstrates a good productivity.

Our research revealed the fact that less than 15% of the analysed projects are using these productivity factors. Additional we could observe that the progress revisions procedures are not respected.

Progress revision by contractor can only be initiated following prior approval of project owner management team.

Progress revision can be triggered by:

- master Schedule revision;
- a significant increase or decrease of the contract scope of work.

New integrated master schedule baseline and progress S-Curves shall then be re-defined.

## **4. Management Tools and Methodologies**

The conducted research indicated the needed aspects for integrated management of the investment program, as well as the percentile values of respecting these, showing the importance of project integrations for developing the frame for summarized information and reports. Very important in generating summarized reports is the weighting system. During our research it was concluded that the most trustfully weighting system for the activities is based on quantities transformed by a productivity ratio in equivalent MHRS.

This approach is most effective when the completion performance milestones are time related.

### 4.1. Overall S-Curves

It was revealed that the most common and frequently used reports in Portfolio Project management are the S-Curves. A very sensitive point in developing the overall S-Curves is the weighting factors which contribute to the overall figures (Fig.no.3).

The execution S-curves consists out of three separate curves:

- the ‘baseline’ or target curve (dashed line).

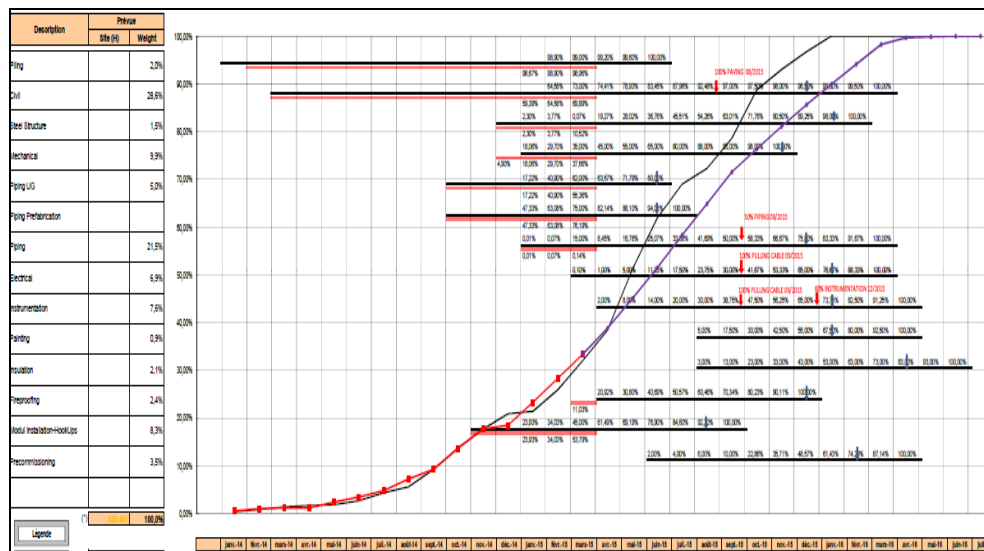
At a certain moment after all the elements were agreed the execution plan will be frozen. This consolidated schedule will serve as a reference during the whole execution period. All progress reporting will be done referencing this schedule. The values cumulating to this curve belong to every single activity in the execution schedule. Therefore every possible cut through can be produced on request.

- the Actual earned curve.

Progress is reported as percentage earned from the original budgeted man hours and quantity per activity. The accumulation per time period of these earned hours and executed quantity is represented in this actual curve.

- the current forecast.

All work to do, not yet performed, is accumulated in to the forecast curve, including. This curve must be resource leveled on the available man power to show the feasibility of the project.



**Fig. no. 3. Proposal referring to overall weighted portfolio S-Curve**

In the above graph are on the X-vertical axis the percentages from 0 to 100%; and on the Y-horizontal axis the time period (months) to completion. In addition in the presented S-Curve report, were included also the weightning summarized at discipline level.

#### 4.2 Developing of the overall Critical Path and CPLI (Critical Path Length Index) analysis

The conducted research shown that although the critical path concept is well known, applying it to integrated project portfolios is difficult due to the issues related to project integrations.

The Critical Path represents the logic chain of driving interrelated activities, tasks and/or milestones which forecast the completion date. Its length is represented in the time window (number of days/hours) to the early finish date of milestone representing investment program completion (Schwindt and Zimmermann, 2015). The conducted research pointed the importance of the overall critical path resulted from the projects integration in a portfolio. Without an overall critical path, the portfolio completion milestones dates are not reliable; these can be only estimated. The overall Critical Path is not resulted from the sum of the distinct separate projects Critical Paths, it result after the integration and point the Investment program completion date (Fig.no.4).

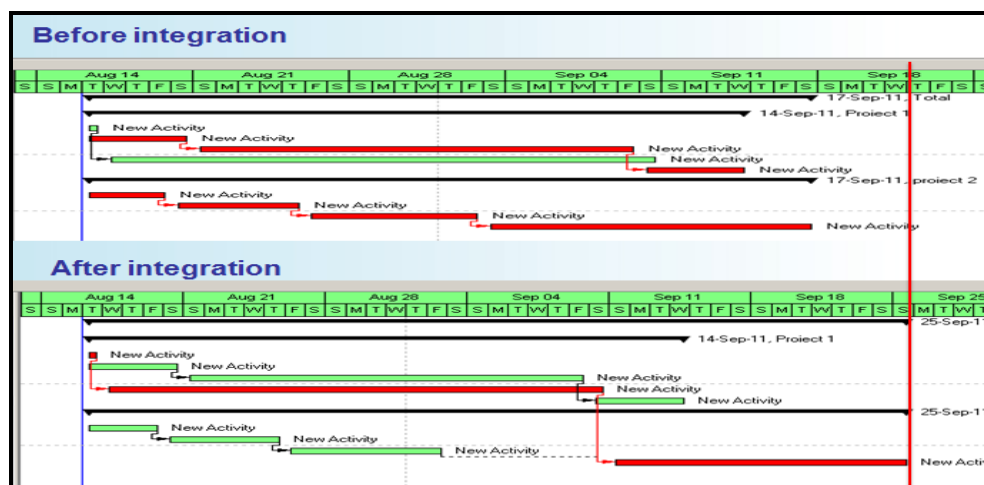


Fig. no. 4. The results of project integration on Critical Path

Source: adapted from Sandru M. and Olaru M., 2013, pg.440.

What is important at portfolio level is the overall time float of each activity toward the portfolio objectives, the total float that these have for individual project objectives is secondary. In common practice the project managers, who manage individually projects are focused mostly on their own projects performance targets and critical activities, this approach of each project manager, conduct to an overall week portfolio management prioritizing activities towards each project priorities which are not always in concordance with the portfolio priorities.

Following the conducted research the authors propose the use of (CPLI) Critical Path Index as a very efficient instrument for establishing the criticality from timing perspective of the investment program. In portfolio analysis this coefficient shall be applied in case of the overall resulted critical path, and not to the local projects critical paths.

This coefficient can be applied only after the validation of the complete integration of the portfolio schedules on a reliable overall critical path and is calculated as (see Formula (1):

$$\text{CPLI} = (\text{Critical Path Length} + \text{Total Float}) / \text{Critical Path Length} \quad (1)$$

The resulted value is KPI which indicate the ratio of Total Float versus the remaining duration of the overall Critical Path. I.e 10 days Total Float on a Critical Path with 50 days remaining duration, will give a CPLI of 1.2, showing a manageable risk on timely completion date achievement. If the Critical Path has a remaining duration of 500 days the CPLI will indicate a value of 1.02 although above the targeted value 1, will show a significant bigger risk related to the timely completion date. Therefore we can state that the CPLI indicate the relative efficiency needed in order to achieve in time the completion milestone.

#### 4.3. Baseline Execution Index (BEI)

Baseline Execution Index (BEI) indicates the number of completed activities as a ratio to the planned activities for the specific period according to the saved referential (Baseline Schedule).

Although this methodology is well appreciated by the management team, in order to be a reliable and trustfully analysis it involves that the detailed schedule activities to be in the same range of weighting. Big discrepancies in weights will offer confusing results that will induce false conclusions.

The results of the conducted research shown the limitation of such indexes by not taking into account the relative weight of the activity, into the entire as detailed in this paper.

The wBEI developed by authors as synthetic measuring KPI, reflect the approach of the execution in comparing with the initial planned number of activities and their weight. Resulted figures are compared with 1 which indicate that the “As Build” follows accurately the as “As Planned”, figures above 1 indicate accelerations in comparing with the planned number of activities and quantities in equivalent MHRS, values lower than 1 indicate that less number of activities and quantities in equivalent MHRS were completed.

During the conducted research and consulting activities, the authors have shown the limitations of this indicator and proposed to be used in concordance with adjusting weighting factors based on planned/executed Man-hours (MHRS) and budgeted costs, as detailed above.

#### 4.4. Proposals related to the milestones achievements and investments goals.

As above detailed, in the conducted research the IMS (Integrated Master Schedule) is considered the time phased schedule, built on the logic of interactions criteria of main events and tasks, at the portfolio, level. An activity in the IMS must have expected duration and resource requirements, according to the source data at the individual, separate project schedule level.

The IMS will be built by identifying and including the logic of Lot Schedules interrelationships through the main events (Milestones and Tasks) resulted from the Process and Commissioning sequences.

Thus for simplifying the summarized reporting for progress tracking, main key events at the portfolio level can be set up and analyzed. Milestone reporting are addressed to the high management levels. Those reports offering only an overall helicopter view.

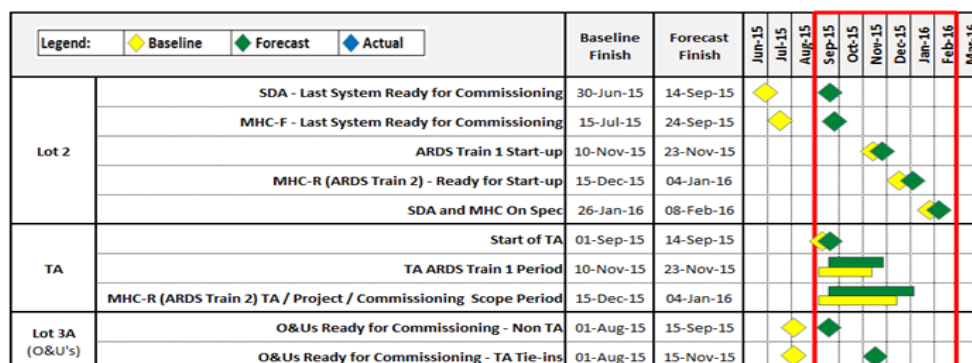


Fig. no. 5. Milestone reporting in portfolio investments from energy field

The Milestones, main events are considered key points at the Lot, individual Schedule or IMS level which indicates a level of the progress achieved e.g. First/Last PO placed, ROS, Site availability, ISO's IFC, System/Subsystem Mechanical Completion, etc.

For the management team a good and accurate track of those milestones guaranties the completion of the investment program in the assumed performance targets (Fig. no. 5).

## 5. Conclusions

The results of the research conducted by authors shown that, the procedural approach and method statement of portfolio management and investment programs are a high interest topic for project management specialists.

Although in the literature exists significant documentation related to the portfolio management, case studies and practical methodologies are very few do to the particularities of each investment portfolio. Thus, well-defined methodologies and techniques for project management are in place. Starting from these can be developed performing integrated management systems, once the strategies and objectives were defined.

Also be noted that applying the procedural approach resulted from our research, can address to a more focused and reliable investment portfolio planning and progress measurement system.

On the other hand, the result of the research demonstrated that the designing and planning of the portfolio investment frame and strategy have a major role in optimizing the

investment program. The focus at individual distinct projects is not objective in following the investment program success. What matter are the overall indicators toward portfolio.

Our research clearly show that, in order to have a reliable projects integration at portfolio level, the integration process shall be focused in identifying the technological interdependencies between the elementary activities of different projects.

During the conducted research and consulting activities, the authors have shown the limitations of the indicators which do not use adjusting weighting factors based on planned/executed Man-hours (MHRS) and/or budgeted costs.

These results shall be considered a starting point for future research to optimize the portfolio and investment programs management methodologies, on today's market being a gap of experience and knowledge in this area.

Nowadays simple projects are rare, most of investments programs are build by sum of projects with different contractors and objectives. To manage these efficiently is the answer searched through our research.

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