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Overcoming the Challenges of Large Capital Programs/Projects

Applying Lessons Learned from Extended Power Uprates

Introduction

- Effective capital program/project delivery is a critical competency for any electric utility to achieve high performance
- However, project scope creep, schedule delays, and cost increases have become the rule rather than the exception
- Over the past 10 years, the electric utility industry has seen large demands on its projects and construction management organizations to ensure compliance with a number of concerns, including:
  - Plant retrofits and conversions
  - Ash pond closures
  - Fukushima modifications
  - Security upgrade requirements
  - Extended power uprates (EPUs)
- Large capital programs/projects come with a variety of complicated planning, implementation, and workforce/vendor management challenges
- Using EPU projects as an example, we will provide you with ways to overcome these challenges for any large capital program/project

Lessons learned from extended power uprates can be applied to any large capital program/project.

Overview of Power Uprates

- Power uprates allow utilities to generate more electricity from their existing nuclear plants
- Since the 1970s, the NRC has approved 154 uprates, which have collectively added generating capacity equivalent to about seven new reactors
- Three types of uprates are available to a nuclear plant operator: measurement uncertainty recapture, stretch, and extended

Power Uprate Type	Increase to Licensed Power Levels	Plant and System Impacts
Measurement uncertainty recapture	< 2%	Implementing improved techniques for calculating reactor power, e.g., utilizing state-of-the-art devices to more precisely measure feedwater flow
Stretch	2 to 7%	Changing instrumentation settings without major plant modifications
Extended	7 to 20%	Significantly modifying to major pieces of non-nuclear equipment, e.g., high-pressure turbines, condensate pumps and motors, main generators, and transformers

Source: www.nrc.gov, Backgrounder on Power Uprates for Nuclear Plants

- As shown in the table above, implementing EPUs presents the biggest project challenges, given the need to significantly modify major pieces of plant equipment

EPU Project Challenges

EPU projects pose significant scope, implementation, and workforce management challenges

- Scope
  - Scope is fluid as the EPU project is implemented
  - Outages are typically much bigger in scope than a refueling outage, requiring the significant change-outs or upgrades of major equipment
  - Changes to the plant configuration (structures, equipment, and systems) must be precisely documented
- Implementation
  - In many cases, the work is done while other units are still in operation
  - A high degree of project control rigor is required to accurately track cost and schedule against evolving scope
  - Physical security, ALARA limits, lock-out/tag-out requirements, etc., make the work environment very complex
- Workforce management
  - A large number of skilled teams (craft workers and supervisors) that may have never worked together are involved
  - Some trades and/or skills are likely to be in short supply
  - Many workers are new to a nuclear plant work environment and lack knowledge of nuclear safety and quality standards

Sources:
1. IAEA Nuclear Energy Series No. NP-T-3.9, Power Uprate in Nuclear Power Plants: Guidelines and Experience, 2011
2. Von Lazar, Laszlo, "Lessons Learned from Successful Nuclear Uprate Projects", Nuclear Power International Magazine, Volume 6, No. 4, July/August 2013

Lessons Learned from Recent EPU Efforts

- Planning for contingences is critical. In some cases:
  - Actual costs more than doubled over initially planned costs
  - Outage durations were as much as 25% longer than planned
  - Additional outages were required to complete the work
- Costs and schedules should include contingencies for productivity issues, replacing vs. repairing components, and licensing delays
  - Preliminary cost estimates, based on conceptual scope, may not capture all of the work necessary to complete the project
  - Some components that are initially expected to be repaired or recertified will require replacement, i.e., during configuration control verification, perform a detailed drawing walk-down of pumps, motors, valve controls, etc., to minimize scope surprises
  - Major construction activities at an operating nuclear plant, many of which occur in remote and radiologic-controlled portions of the plant, can cause significant implementation difficulties and delays
    - Space for installation can be extremely tight and may require removal or working around hundreds of interferences
    - Productivity can be slowed due to the specialized and time-consuming procedures to ensure worker safety in radiologic-controlled and electrically sensitive areas of the plant
  - Increasingly conservative regulatory requirements outside of a company's control can cause significant licensing delays
- Obtaining and retaining experienced workers is a challenge
- Active management of vendors is required to ensure productivity is maintained, issues are raised, and progress is on schedule

EPU Project Keys to Success

Work Environment

- Encourage workforce collaboration and the ability of employees to voice concerns early and often to avoid costly errors, re-work, and safety hazards, i.e., maintain a focus on quality and safety
- Develop a self-critical culture focused on improvement and efficiency
- Recognize that the EPU team can not anticipate all the changes that will occur during the project
- Utilize project management technology where possible to improve efficiency and communication
- Hold regular project team meetings and invite senior leadership periodically to reinforce the priority of the project

Planning

- Be honest and realistic about the complexity and uniqueness of the EPU project; investing early in planning and current state analysis can save a lot of rework
- Recognize that the planning process continues all the way to project completion and that the EPU team should always be looking to improve costs, schedule, and general efficiency
- Make benchmarking trips and incorporate lessons learned and insights, e.g., NEDO-33159, from recent EPU and stretch uprates projects into planning
- Bring in field engineers and/or craft supervisors early in the process for review and comment on actual configuration vs. drawings and equipment installation implications
- Hold combined design reviews with members from different disciplines; utilize the experience and expertise from each discipline to come up with a collectively better solution
- Develop integrated work packages to improve efficiency and overall performance

Sources:
1. IAEA Nuclear Energy Series No. NP-T-3.9, Power Uprate in Nuclear Power Plants: Guidelines and Experience, 2011
2. Von Lazar, Laszlo, “Lessons Learned from Successful Nuclear Uprate Projects,” Nuclear Power International Magazine, Volume 6, No. 4, July/August 2013

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EPU Project Keys to Success (Cont'd)

Implementation

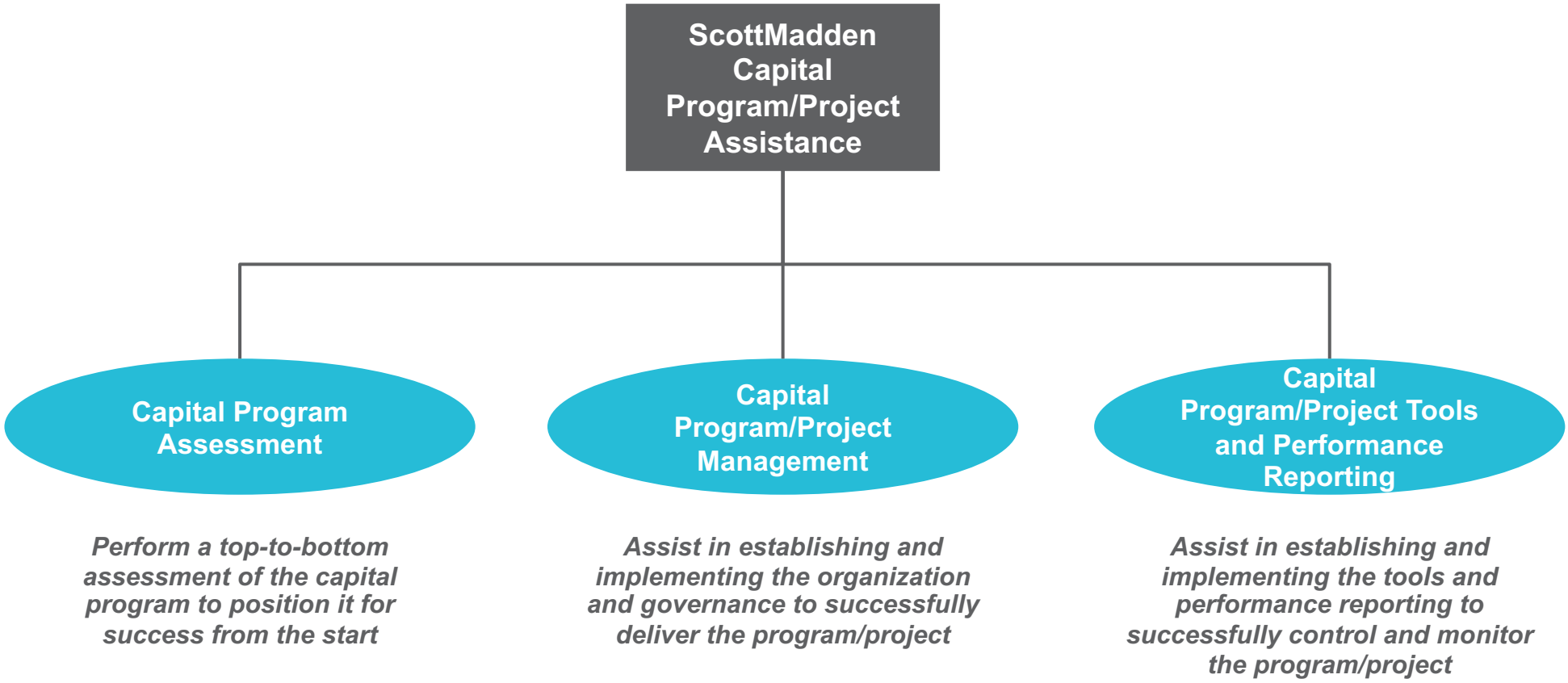
- Manage like a large-scale engineering, procurement, and construction project and not like a modifications project or refueling outage, e.g., funding is stage-gated
- Collect accurate data and monitor relevant performance metrics throughout the EPU project
- Conduct periodic independent project audits using industry experts with previous EPU experience
- Involve employees who will operate the plant during implementation
- Ensure operating staff are adequately trained on how the plant will operate after the power uprate, e.g., operations, maintenance, engineering, radiation protection personnel, etc.
- Update all affected documentation, e.g., operating and maintenance procedures, to reflect the new operating conditions
- Focus on procedure development, training, and simulator modeling to help verify actual plant response vs. expected plant response in power uprated conditions

Vendor/ Contractor Alignment

- Align vendors and contractors with project objectives and the uniqueness of the project
- Ensure vendors and contractors are aware of and held to the tenets of nuclear safety and align their nuclear safety culture with that of your company
- Work collaboratively with contractors and combine cost, schedule, and human performance monitoring tools and processes
- Ensure contracts have clear terms and conditions and are very specific in scope and timing
- Plan for vendor handoffs of work products and resolve disputes promptly to reduce idle vendor time

Sources:
1. IAEA Nuclear Energy Series No. NP-T-3.9, Power Uprate in Nuclear Power Plants: Guidelines and Experience, 2011
2. Von Lazar, Laszlo, "Lessons Learned from Successful Nuclear Uprate Projects," Nuclear Power International Magazine, Volume 6, No. 4, July/August 2013

How ScottMadden Can Help

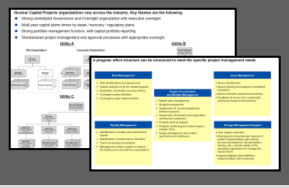


Capital Program Assessment Overview

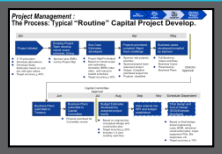
ScottMadden's Capital Program Assessment examines how the capital program is implemented—from top to bottom—with a look at the PMO and a review of the performance reporting and tools in place.

Program Management Office

Step 1: Capital Program Analysis

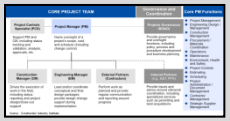


Step 2: Process Evaluation



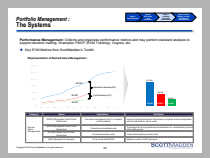
EPU Project

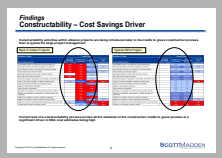
Step 3: Organization Analysis



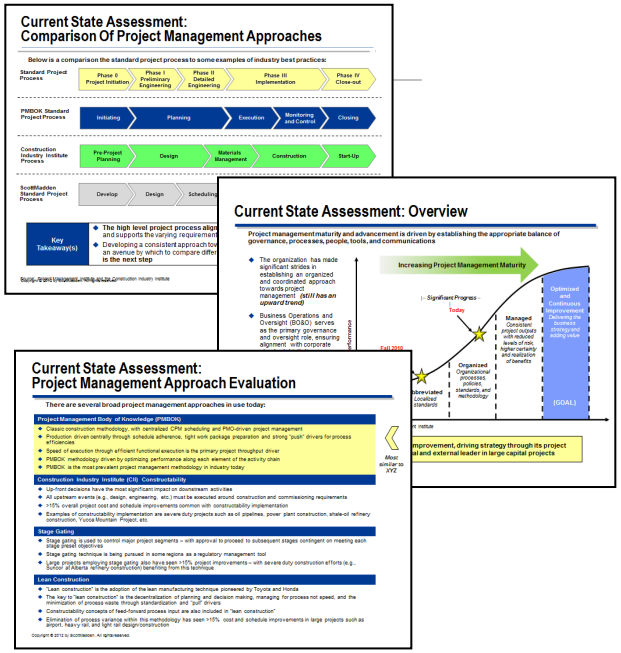
Step 4: Execution Assessment

Step 5:
Performance Reporting and Tools Evaluation





Step 6: Recommendations and Action Plan



ScottMadden's approach analyzes these critical areas to provide a detailed assessment of your capital program with actionable recommendations.

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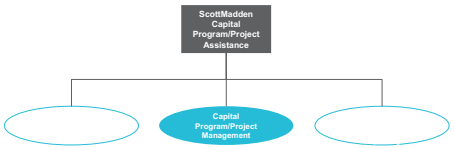
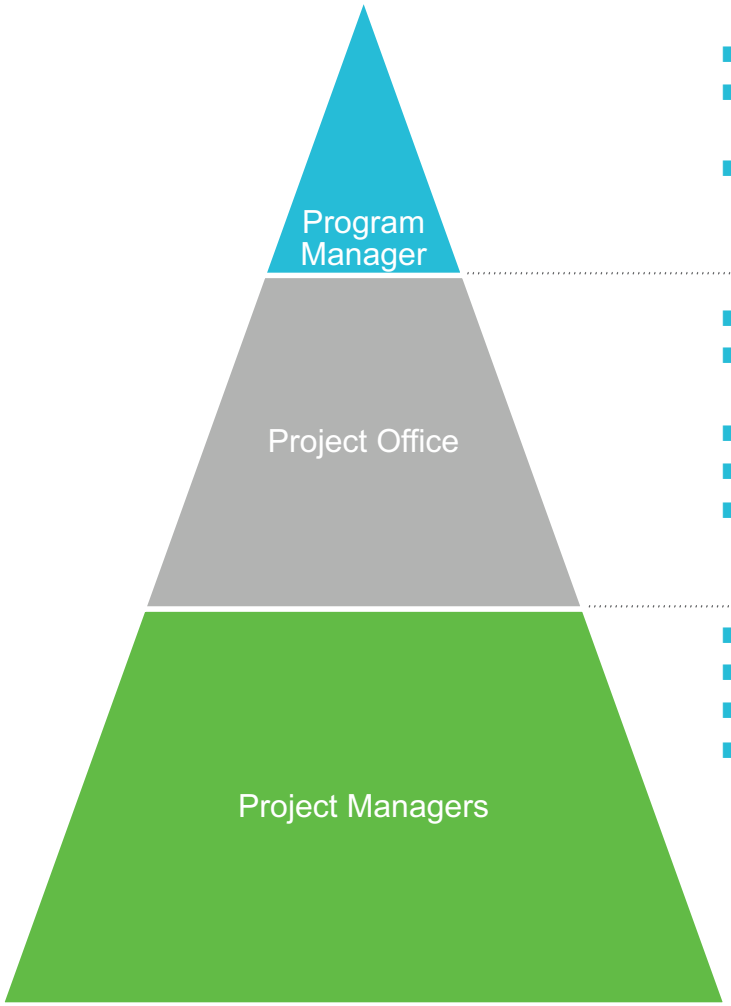


Capital Program/Project Management Overview



	Focus On	Tools
Program Manager	■ Organization and governance ■ Functional relationship management ■ Partnership with other entities	■ Performance Dashboard ■ Issue List (high impact and level) ■ Monthly Progress Report ■ Risk Analysis and Mitigation Plan (high impact and level)
Project Office	■ Inter-project coordination ■ Inter-project resource coordination ■ Cross functionalities ■ Best practice usage ■ Documentation management	■ Projects List ■ Project Procedures ■ Project Dashboard ■ Milestones Tracking ■ Issue List (Aggregated) ■ Risk Analysis and Mitigation Plan (Aggregated) ■ Weekly and Monthly Progress Reports
Project Managers	■ Project milestones ■ Costs ■ Times ■ Business/technical goals	■ Project Plan ■ Project Documentation Management ■ Milestones Tracking ■ Risk Analysis and Mitigation Plan ■ Change Request Management ■ Issue List Management ■ Project Baseline and Progress Report ■ Weekly Progress Meeting Minutes ■ Weekly Progress Report ■ Monthly Progress Report

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Capital Program/Project Management Tools and Performance Reporting Overview

Performance Dashboard

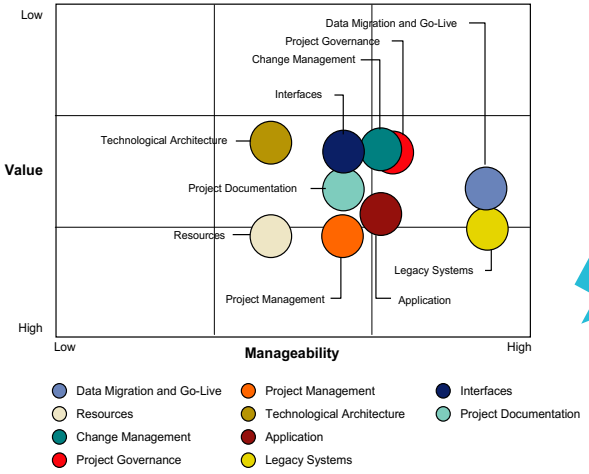
F.G.P. — PROJECTS DRIVING BOARD

Order	Project	Description	Project Manager	Type	Impact	Status	Tendency (previous) 30-Apr-01	Tendency (actual) 31-May-01	TIME Baseline Start	Baseline End	Forecast End	COST (Euro) Budget	Actual	Forecast	Open issues & Critical Points
CMFR0027	PRGT00PB	Powertrain	Sorrenti	F	M		⇨	⇨	1-Nov-00	31-Aug-01	31-Aug-01	26,550	26,085	26,550	
CMEV0007	PRGT1572	Impl. Vernole Plant	Serafino	F	M		⇨	⇨	15-Jan-01	28-Sep-01	28-Sep-01	82,633	0	82,633	
CMSP0015	PRGT2982	HRMS new . Devel.	Pulty	F	H		⇨	⇨	1-Jan-01	31-Dec-01	31-Dec-01	108,785	0	108,785	
CMSP0015	PRGT3044	Web professional	Pulty	F	M		⇨	⇨	15-Apr-01	31-Dec-01	31-Dec-01	71,975	0	71,975	
CMSP0039	PRGT0017	Estesa	Di Carlo	O	L		⇨	⇨	7-May-01	30-Jun-01	30-Jun-01	23,750	0	23,750	
CMSP0015	PRGT3047	I.I.S. HR FGP	Pulty	F	L		⇨	⇨	1-Jan-01	31-Jul-01	31-Jul-01	77,468	0	77,468	
CMSP0028	PRGT0014	Engine Sperim. Appl.	Brezigar	O	M		⇨	⇨	12-Apr-01	31-Dec-01	31-Dec-01	158,479	0	158,479	
											Total	549,640	26,085	549,640	

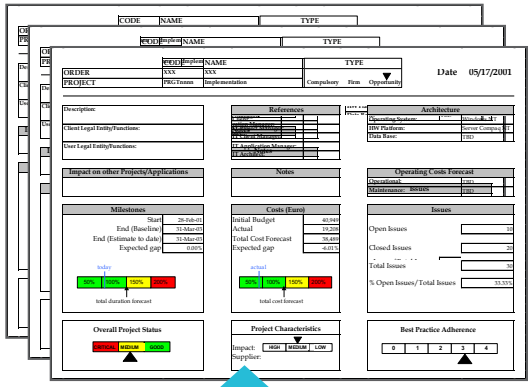
Legend

Type		Impact		Status		Tendency	
	Compulsory (O)		High (H)		Critical	⇨	Flat
	Firm (F)		Medium (M)		Medium	⇧	Raising
	Opportunity (O)		Low (L)		On track	⇩	Falling

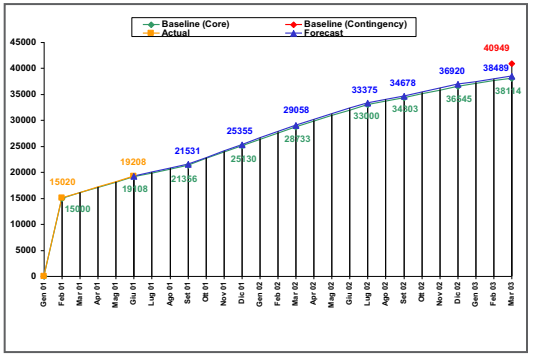
Risk Map



Project Scorecard



Cost Tracking



Progress Report

PROJECT	PRGTnnnn	Implementation	MONTHLY STATUS REPORT
REF.	1 / 24		
MONTH	MARZO 2001		
PHASE	PROTOTIPAZIONE		

PROJECT STATUS

E' stato definito il System Integrator. E' stato definito il Piano di progetto.
E' stata impostata la proposta di Struttura Organizzativa di Progetto. E' stata impostata la baseline per i costi di Progetto
Sono state attivate le Procedure di Gestione Scope Change Request, di Gestione Issue List e di Gestione della Documentazione.
E' stato Definito il tool di gestione della documentazione di Progetto. E' stata impostata l'Analisi del Rischio.

OPEN ISSUES	ACTIONS	RESPONSILE	DUE DATE
1 - L'Ambiente di Prototipazione non è disponibile.	Predisporre ambiente prototipazione	IT Project Manager	06/04/01

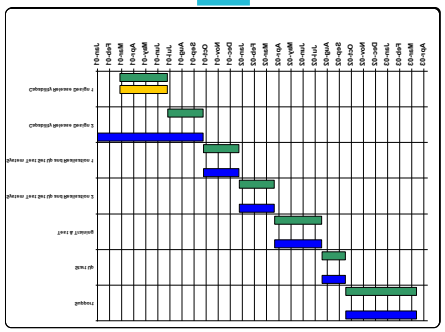
NEXT STEPS

Ufficializzazione Struttura Organizzativa di progetto. Definizione dei componenti del team da parte dei Responsabili/Referenti.
Verifica profilo di spesa e budget Architettura Tecnologica. Impostazione attività di Quality Assurance.

APPROVED CHANGE REQUESTS

Nr.	Description	Approval Date	Allocated Contingency

Schedule



Costs Detail

ORDER | COMM | NameComm | BASELINE VS ACTUAL VS FORECAST | F.G.P.
PROJECT | PRGTnnnn | Implementation | Back to index

Cost Type	Cost Element	COST (Euro) Baseline	Actual	Forecast	Notes
System Development	Development & Implementation	18,550	2,434	18,550	
	External Resources	0	0	0	
	Operational/Applicational Mngt	3,783	3,783	3,783	
	Total System Development	22,333	6,217	22,333	
HW/SW Management	HW/SW Design & Consultancy	1,572	1,572	1,572	
	HW/SW Acquisition	6,500	6,500	6,500	I costi relativi all'architettura tecnologica saranno dettagliati al termine
	SW Licences	3,145	3,145	3,145	della fase di definizione dei requisiti
	Total HW/SW Mgnt	11,217	11,217	11,217	
	Total External Costs	33,550	17,434	33,550	
	Total Internal Resources	4,564	1,674	4,564	
	Partial Project Total	38,114	19,108	38,114	
	Contingency	2,835	100	375	Sono state attivate 5 Scope Change Request
	Overall Project Total	40,949	19,208	38,489	

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