

Critical Success Factor Analysis of
Millau Viaduct Project

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A *genda*



1. Introduction
2. Research Methodology
3. Conceptual Framework
4. Millau Project Analysis
5. Results and Implications
6. Conclusion and Recommendation



*An excellent
ambience "As project manager, we controlled
every stage of the erection of
the viaduct during these three years of construction.
Our recommendations
were always taken
into account by the teams on
the worksite. And the ambience
on site was truly excellent.
I am not sure that I shall ever experience
another construction site like Millau".*

Abel Benzina,

engineer with SETEC TPI."





Introduction

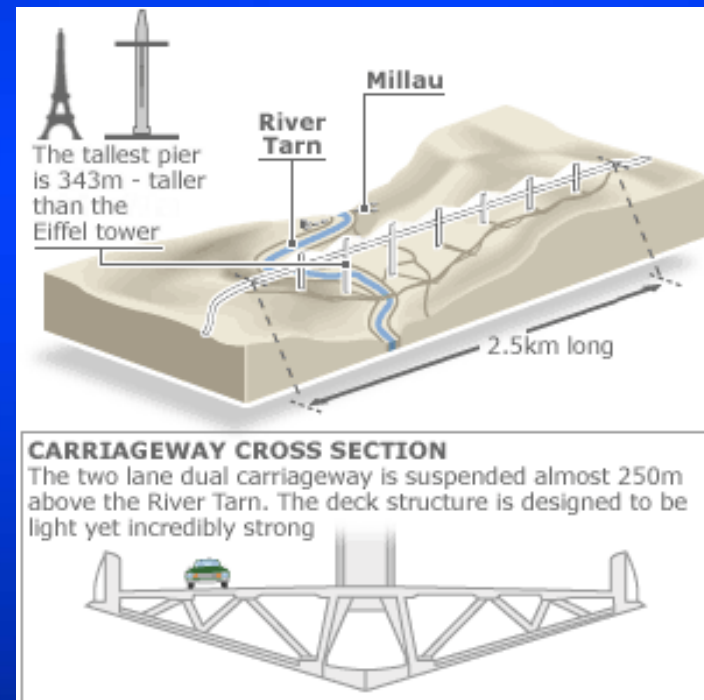
- Millau Viaduct Key Facts

Millau Viaduct Key Facts

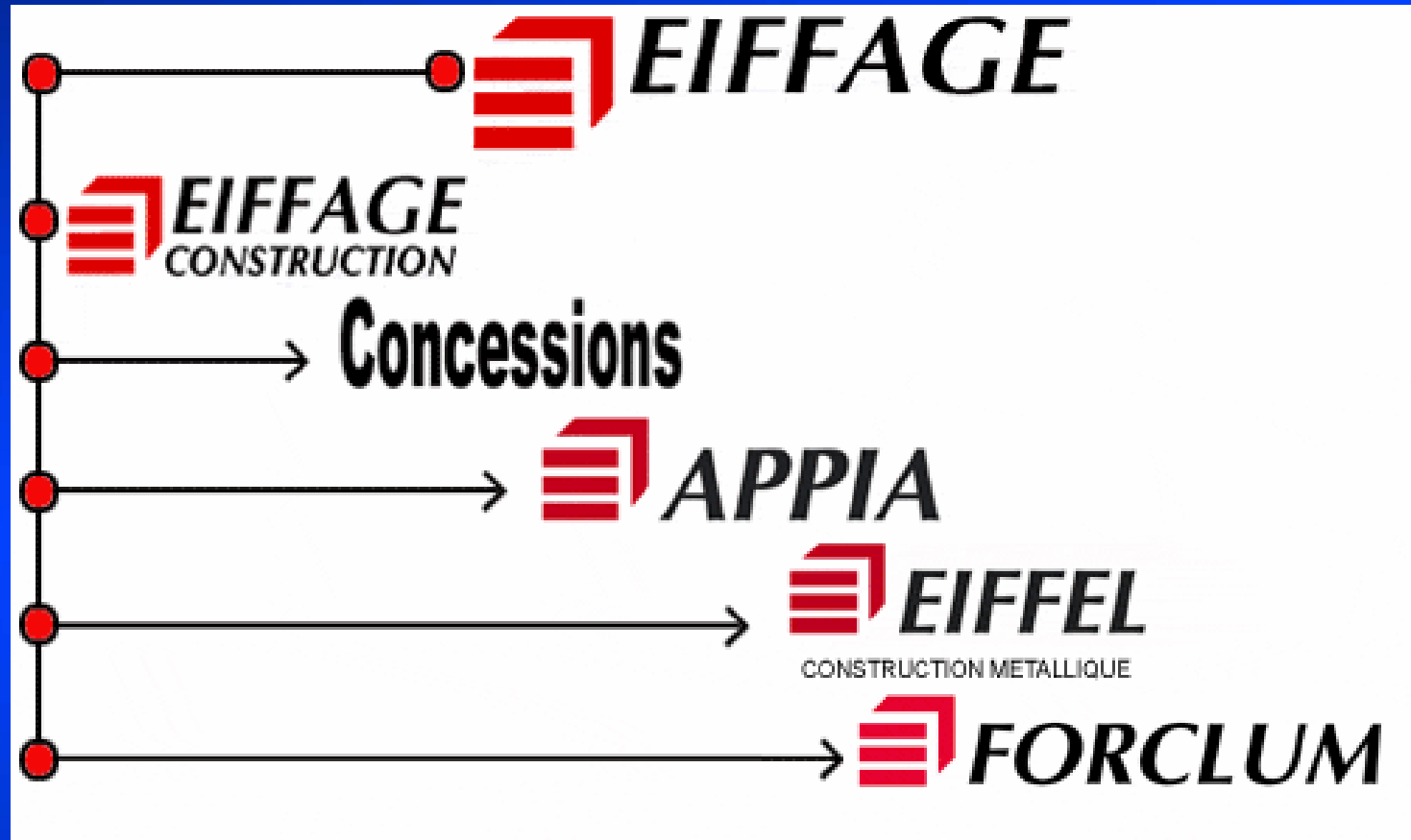


- An Engineering Marvel and an Architectural Masterpiece
- World's Tallest Cable-Stayed Bridge
- A Mega-Project on Schedule
 - 39-month (revised) Contract
 - Completed one month earlier
- Start: October 2001
Finish: December 2004
- Within Budget
 - €400 million (construction)

More Facts...



Construction Consortium

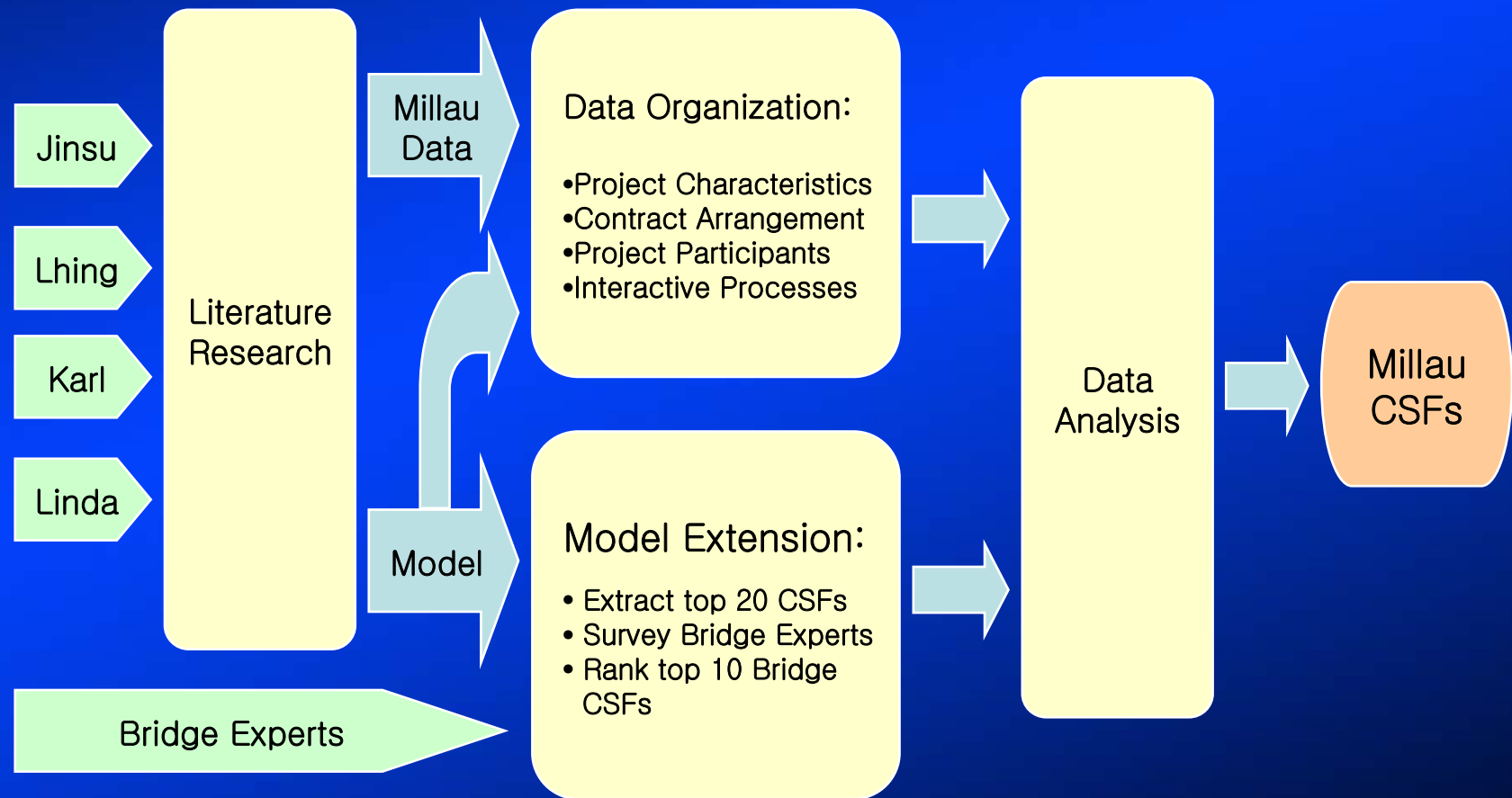




Research Methodology

- Framework Selection
- Millau Data Collection Path
- Model Extension Data Path

Research Methodology

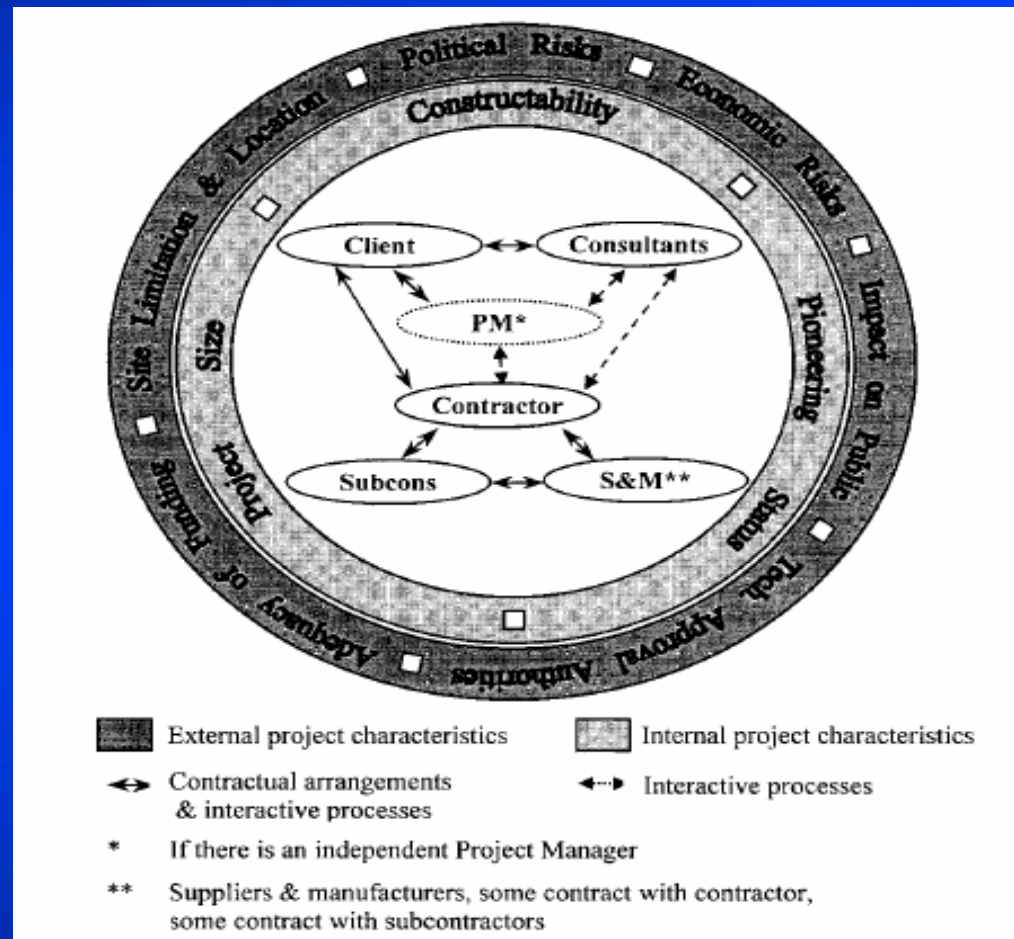




Conceptual Framework

- Project Environment
- Hierarchical Model
- Critical Success Factor (CSF)

Typical Construction Project Environment

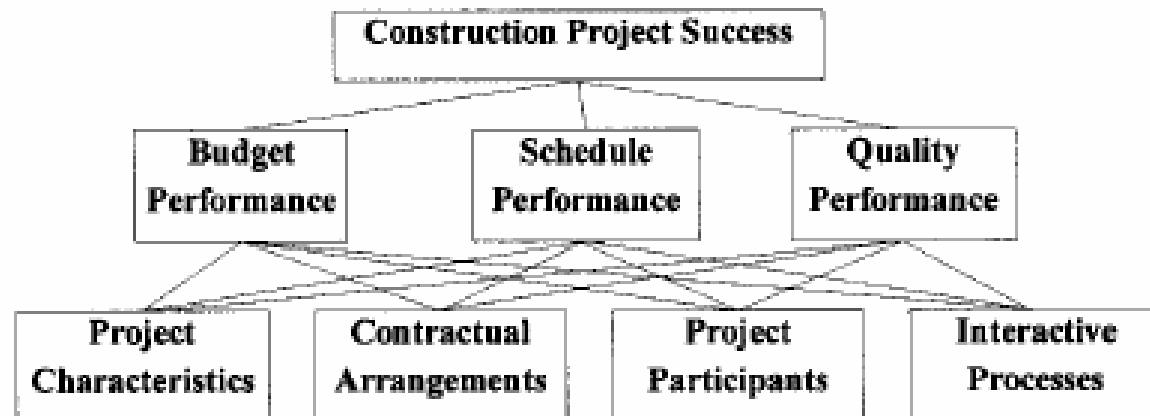


Hierarchical Model

Goal

Objectives

Aspects



Success Factors...

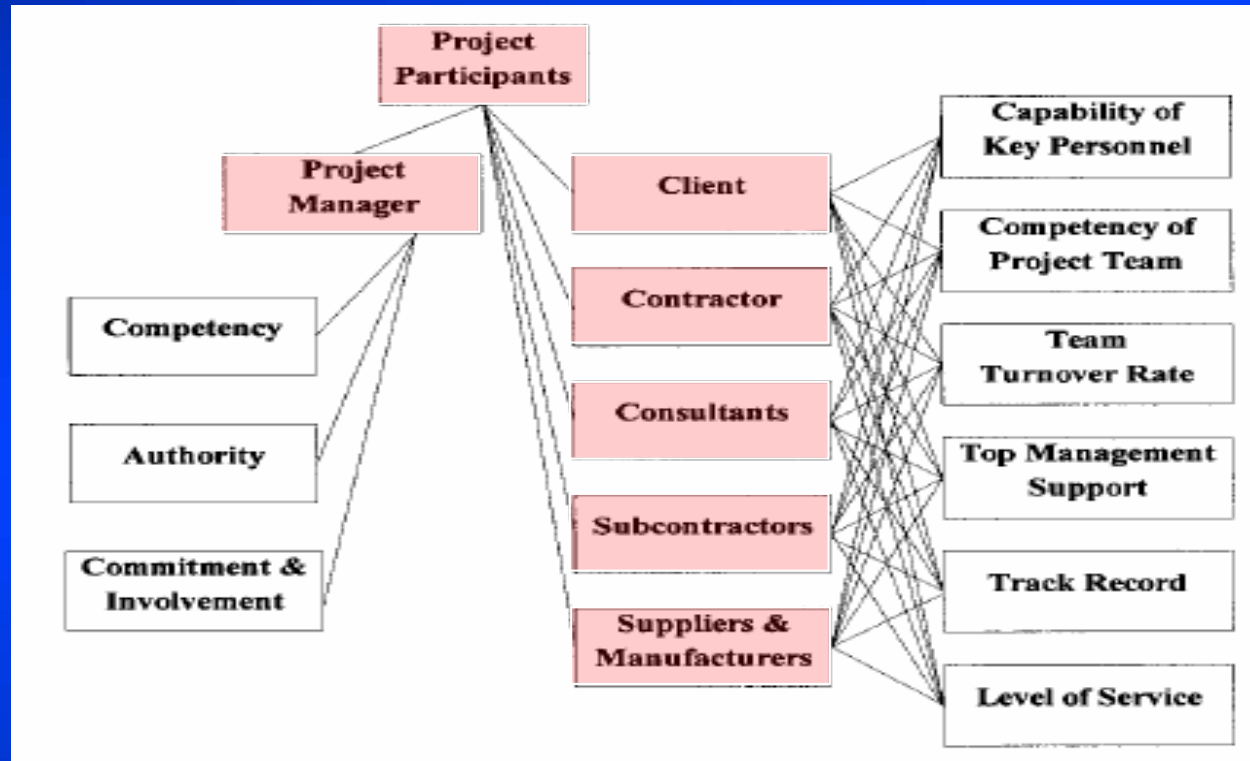
Project Characteristics

- Political risks
- Economic risks
- Impact on public
- Technical approval authority
- Adequacy of funding
- Site limitation & location
- Constructability
- Pioneering status
- Project Size

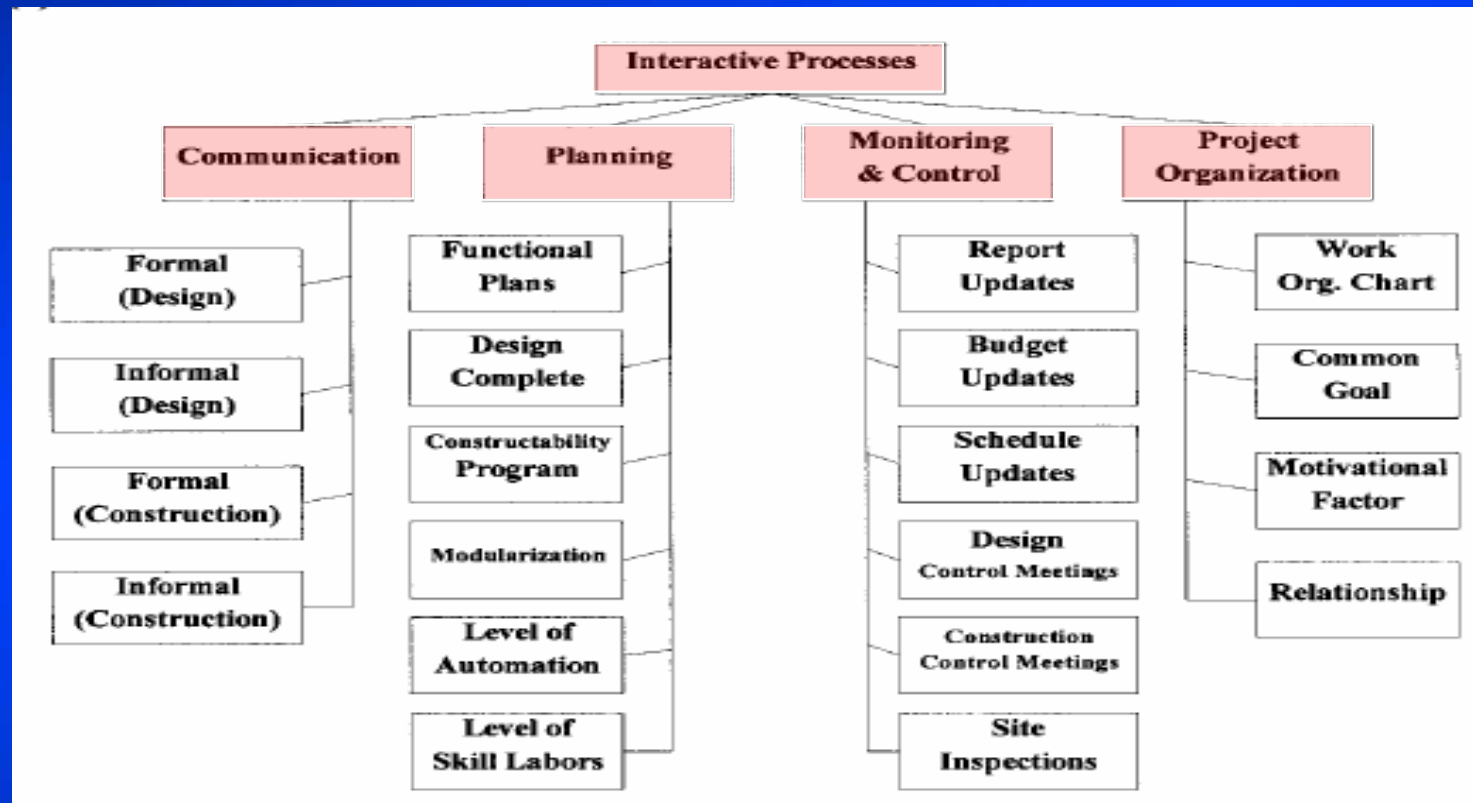
Contractual Arrangements

- Realistic obligation
- Clear objectives
- Risk identification
- Adequacy of plans & spec
- Formal dispute resolution process
- Motivation / Incentives

Project Participants Factors



Interactive Processes Factors



Top 20 CSFs for Construction

TABLE 4. Ranking of CSFs for Different Project Objectives

Success-related factor (1)	Av (2)	Organization Type				Av (7)	Organization Type			
		O1 (3)	O2 (4)	O3 (5)	O4 (6)		O1 (8)	O2 (9)	O3 (10)	O4 (11)
	Budget performance					Schedule performance				
Adequacy of plans and specifications	1	1	1	1	3	1	2	3	2	—
Constructability	2	3	4	2	—	2	4	5	1	—
Economic risks	3	4	—	3	2	—	—	—	—	—
Realistic obligations/clear objectives	3	—	2	—	5	6	—	1	3	3
PM competency	5	2	—	—	4	4	1	—	—	2
Adequacy of funding	6	5	—	—	—	—	—	—	—	5
Budget updates	7	—	3	—	—	—	—	—	—	—
PM commitment and involvement	8	—	—	—	—	3	5	—	—	—
Contractual motivation/incentives	9	—	5	—	—	5	3	—	—	4
Risk identification and allocation	10	—	—	3	—	—	—	—	—	—
Political risks	—	—	—	4	—	—	—	—	—	—
PM authority	—	—	—	—	1	—	—	—	—	1
Schedule updates	—	—	—	—	—	7	—	2	5	—
Construction control meetings	—	—	—	—	—	8	—	4	—	—
Capability of contractor key person	—	—	—	—	—	9	—	—	—	—
Site inspections	—	—	—	—	—	10	—	—	—	—
Pioneering status	—	—	—	—	—	—	—	—	4	—
	Quality performance					Overall				
Adequacy of plans and specifications	1	1	2	1	4	1	2	1	2	4
Constructability	2	3	3	3	5	2	3	3	1	—
Site inspections	3	4	4	2	—	7	—	—	5	—
PM commitment and involvement	4	—	—	—	—	3	5	—	—	—
Realistic obligations/clear objectives	5	—	1	5	2	4	—	2	3	3
PM competency	6	2	—	—	3	4	1	—	—	2
Construction control meetings	7	—	5	—	—	8	—	—	—	—
Formal communication (construction)	8	—	—	—	—	9	—	—	—	—
Capability of contractor key person	9	—	—	—	—	—	—	—	—	—
Design control meetings	10	—	—	—	—	—	—	—	—	—
Contractual motivation/incentives	10	—	—	—	—	6	4	4	—	—
Pioneering status	—	5	—	—	—	—	—	—	—	—
PM authority	—	—	—	—	1	—	—	—	—	1
Supplier level of service	—	—	—	3	—	—	—	—	4	—
Economic risks	—	—	—	—	—	9	—	—	—	5

Note: Av = average rank; O1 = consultant; O2 = contractor; O3 = client; O4 = project management.

Categorizing Top 20 CSFs

Project Characteristics	Project Participants	Contractual Arrangements	Interactive Processes
(External) <ul style="list-style-type: none"> • Political Risks • Economic Risks • Adequacy of Funding (Internal) <ul style="list-style-type: none"> • Constructability • Pioneering Status 	<ul style="list-style-type: none"> • PM Competency • PM Authority • PM Commitment • Capability of Contractor Key Person • Supplier Level of Service 	<ul style="list-style-type: none"> • Adequacy of Plans and Spec • Real Obligations / Clear Objectives • Motivation / Incentives • Risk Identification & Allocation 	<ul style="list-style-type: none"> • Budget Updates • Schedule Updates • Construction Control Meetings • Site Inspections • Formal Comm. • Design Control Meetings



Millau Project Analysis

- Project Characteristics (External/Internal)
- Project Participants
- Project Contractual Arrangements
- Project Interactive Processes

External Project Characteristics

- Political risk was low
- Millau project is testament to a more visionary France
- The toll collecting for 75 years is not a clear profitable plan.
- € 400 million was funded privately by Eiffage
- All technical approval (Design) was set up before construction started

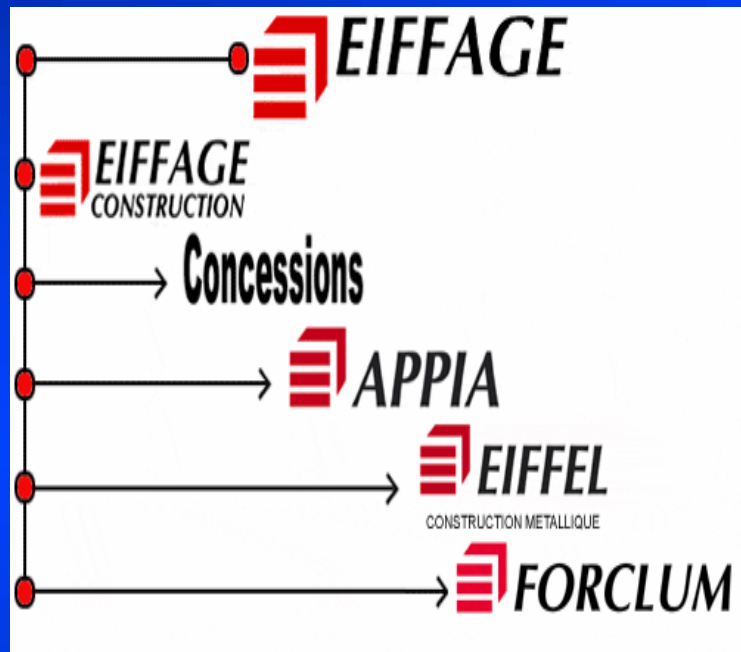
External Project Characteristics

- Millau provide the shortest route between Paris and Perpignan(60Km short and half an hour less driving)
- Millau residents community warmly welcome to accept the project and supporting
- The site was one of famous tour area in the middle of construction and now

Internal Project Characteristics

- The world tallest cable-stayed bridge
- New technical approach was used
- Engineering based design approved in early stage and long term preparation (14 years)
- Construction site was above 200m height location (safety issues)
- Weather changes was significantly considered
- Difficult hilly and rural area across Tran river

Internal Project Characteristics



- Eiffage group have qualified previous constructions records and resources (technology and manpower)
- Eiffage group was the key player in technical decision and constructability

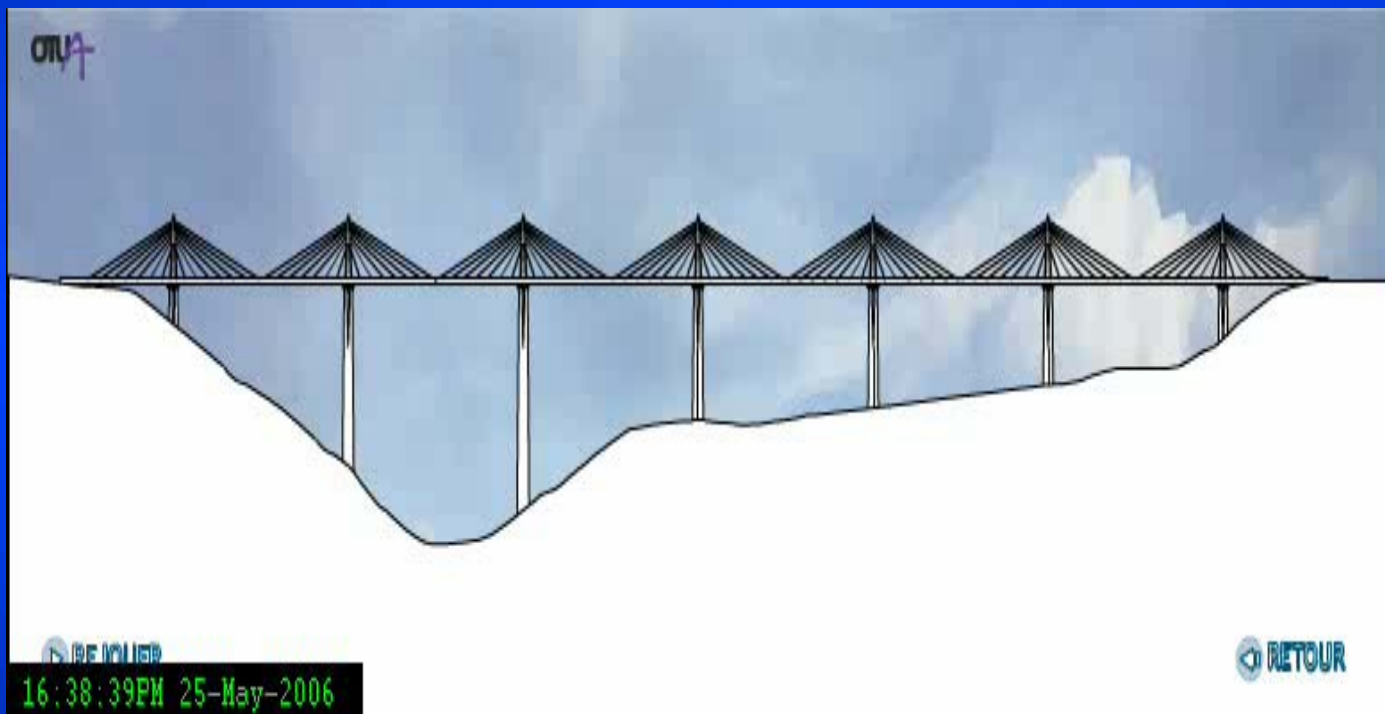
Internal Project Characteristics

Key Numbers

	Details	Numbers
1	Length	2,460 m
2	Width	32 m
3	Maximum height	343 m, i.e. 20 m higher than the Eiffel Tower
4	Curvature	20 km
5	Height of the tallest pier (P2)	245 m
6	Height of the pylons	87 m
7	Number of piers	7
8	Width of each span	342 m
9	Number of cable-stays	154
10	Cable-stay tension	900 t for the longest ones
11	Weight of the steel deck:	36 000 t, i.e. 4 times the Eiffel Tower
12	Volume of concrete	85 000 m³, i.e. 206 000 t
13	Cost of construction:	400 million €
14	Length of the concession:	78 years – 3 years of construction and 75 years of operation
15	Structure guaranteed:	120 years

Construction Key Steps

1. Raising the piers
2. Launching the deck
3. Placing the final voussoir
4. Installing the pylons
5. The cable stays
6. Applying the coating



Project Participants

Client

- Department of Transport and Public Work of France
- The Public / Millau Community

Designers / Consultants

- Michel Virloguex head designer and engineer, later CEVM's adviser
- Foster & Partners architecture firm
- Europe Etude Gecti S.A., Thales Group, and SociEtE D'Etudes R. Foucault et Associes led concrete design
- Belgium's Bureau Greisch S.A., Lige designed steelwork and erection method, and confirm government's calculations

Project Participants

Contractors

- Eiffage's Compagnie Eiffage du Viaduc du Millau (CEVM)
- Eiffel Construction Metallique S.A. handles steelwork
- Eiffage T.P.

Suppliers and Manufacturers

- German-based supplier Peri GmbH and others

Project Manager

- SETEC TPI

Project Participations

Key players

- Architectural design: Foster and Partners
- Design Concept: SETRA
- Structural Engineering: EEG Simecsol and Greisch
- *Building: Eiffage Construction
- *Concessions: Roadways: Appia
- *Electricity: Forclum
- *Metal construction: Eiffel
- Fabricator: Freyssinet (stay cables)
- Launching: Enerpac
- Formwork: PERI Formwork and Scaffolding.

Contractual Arrangements

- Build-Operate-Transfer (BOT) Arrangement
- Identification and allocation of potential risks
- More flexibility over budget and schedule
- Fulfillment of safety and security standard
- Realistic obligations and objectives
- Adequacy and clarity of plans and specifications
- Provision of formal dispute resolution process
- Motivations and incentives

Interactive Processes

- Communication
 - Collaborative problem solving process
 - Conflict resolution process w/ short command chain
- Planning
 - Development of functional plans
 - Completion of design
 - Management of constructability programs
 - High level of modularization, automation and skillful labor

Interactive Processes

- Monitoring and Control
 - Updates
 - Meetings
 - Site supervision and inspection
- Project Organization
 - Flat organizational structure
 - Common goal
 - Excellent working relationships between designers and contractors



Results and Implications

- Interview/Survey Implications
- Critical Factors for Millau

Interview/Survey Implications

- Definition of “success” will determine which critical factors are the most significant.
- Project managers polled all indicated that success was quality of output was more critical than budget or schedule.
- Factors selected as more important by PMs corresponded more closely with quality rankings from model.

Critical Factors for Millau

	Budget Performance	Schedule Performance	Quality Performance
Project Characteristics	<ul style="list-style-type: none">• Millau came to market just as the French government was approaching build-operate-transfer procurement• Constructability - "the design is very much an engineering generated form."• Significant private funding secured by construction consortium	<ul style="list-style-type: none">• Constructability - "the design is very much an engineering generated form."• Advanced weather monitoring system in place to ensure safe working conditions	<ul style="list-style-type: none">• Constructability - "the design is very much an engineering generated form."• Numerous bridge solutions were extensively analyzed, and best option chosen.• Used most advanced technologies (GPS, Laser, self-raising platforms, specific coating, high performance concrete, innovative materials.)

Critical Factors for Millau

	Budget Performance	Schedule Performance	Quality Performance
Contractual Arrangements	<ul style="list-style-type: none"> • Build-operate-transfer contract with the government • Full, flexible control over budget • High level of risk identification and allocation 	<ul style="list-style-type: none"> • Realistic Obligations/Clear objectives • High level of risk identification and allocation • High motivation among participants 	<ul style="list-style-type: none"> • Realistic Obligations/Clear objectives • High level of risk identification and allocation • Sufficient plans and specifications between designers (consultants) and contractors

Critical Factors for Millau

	Budget Performance	Schedule Performance	Quality Performance
Project Participants	<ul style="list-style-type: none">• Eiffage controlled its 400 million Euro privately funded budget• Consortium reduced overall cost as compared with prime-sub contractor arrangement	<ul style="list-style-type: none">• Many workers had long work history with Eiffage. Same culture and same work flow.• SETEC TPI brought in as consultant to assist Eiffage	<ul style="list-style-type: none">• Highly qualified designers, architects and contractors with abundant experience with cable stayed bridges.• Architects are also engineering inclined.• SETEC TPI brought in as consultant to assist Eiffage.

Critical Factors for Millau

	Budget Performance	Schedule Performance	Quality Performance
Interactive Processes	<ul style="list-style-type: none"> Integration of engineering, construction, and operation knowledge and experience Completion of detailed design at start of construction Frequency of control meetings and plan and budget updates during construction Short command chain 	<ul style="list-style-type: none"> Frequent schedule updates Functional plans regarding schedule, work methods, tools, organization, and resource allocation High level of modularity and automation Integration of engineering, construction, and operation knowledge and experience Sufficiency and high quality of equipment Site management and supervision Good team building and communications Short command chain 	<ul style="list-style-type: none"> Communication and collaborative troubleshooting An excellent working relationship between contractors, designers, and consultants Frequency of report updates Site inspections Frequency of control meetings during construction Sufficiency and high quality of equipment Completion of detailed design at start of construction Short command chain Good conflict resolution process



Conclusion and Recommendation

- A couple of questions
- Final Thoughts
- Limitations

A couple of questions

- Was the bridge actually completed on schedule?
 - If the project is extended early and a new completion date is set, on time completion is open to interpretation

A couple of questions

- Was the bridge actually completed on budget?
 - Eiffage secured private funding for this project on the agreement that the French government would buy the project out from them later on. So from the governments perspective so long as the original terms of the contract are fulfilled, it will be on budget. But is that the true budget?

Final Thoughts

- The final assessment always depends on the metrics
- No individual factors can be singled out for the success of the project
- Eiffage consortium idea was critical to success, particularly given the enormity of this project

Limitations

- Majority of background info was taken from Eiffage publications, so some bias regarding processes is possible
- Critical Factors Used are not tailored for bridge construction
- Limit stretching projects may fall outside the realm of traditional project models



Questions & Answers

Thank you for your attention.