Concrete, Steel and ISO 15288

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Abstract. Construction and process life cycle standards were anathema. However in the Netherlands, the ministry responsible for construction of public works, the Rijkswaterstaat, is now specifying ISO standards like ISO 15288 for large infrastructure construction projects. This paper looks at how this is specified and applied, and experience in its use.

1 Background in the Foreground

The construction industry is one of the foundations for a country's well being. It provides the infrastructure upon which all other endeavours build. Without roads, railways and buildings, and even sewage works, society cannot even start to think about commerce, manufacturing and esoteric things like writing software. Construction people think in very concrete terms; e.g. digging holes, building foundations, laying down a road, constructing a bridge or tunnel. The work approach is very item specific, e.g. "what do I need to do to build a bridge?" Even the designers think in terms of the work item, rather than the process of design. Lead designers rely greatly upon accumulated knowledge and experience. Although civil engineers have the civil engineering code - a set of rules and standards for building something, this is very work item specific. The code describes aspects like the sizing of load-bearing beams and columns, what materials to use, etc. So the focus on the work item is in the foreground for any construction project person.

Rijkswaterstaat staff are often civil engineers with in-depth construction experience. They have a world-wide reputation for construction excellence. Projects like the Delta plan on the mouth of the Rhine set world best practice in waterway-estuary construction in the 1980s. The adjustable water barrier construction in the Delta plan is 5 times larger than the Thames barrier in England. The Netherlands government is transforming the Rijkswaterstaat from a construction expert into a construction contract manager. Against this background of item specific work, imposing a process lifecycle standard like ISO 15288 introduces a novel challenge in an industry that has never used process life cycle standards.

2 Best Practice Specification

The Rijkswaterstaat has tendered several highway construction projects in 2011. The two largest projects are for parts of the A-12 and A-15 highways. A-12 runs inland

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near Utrecht. The A-15 project is a 30 kilometre highway running from Vaanplain, south of Rotterdam, to the new Maasvlakte port in the north sea area of the port of Rotterdam. The highway when completed will consist of 5 road lanes in each direction, a new road bridge and tunnel (Botlek) also 5 lanes wide, multiple crossovers and connections to existing roads and thousand of electrical installations. It will have state of the art signalling and traffic controls.

As part of the request for tender, Rijkswaterstaat has specified thousands of requirements, including several hundred around the management systems of the winning constructor. These range from specifying the use of ISO standards including ISO9001, ISO14400 and ISO15288, to local Health and Occupational Safety standards, and even making the fulfilment of requirements meet SMART (pecific, Measurable, Attainable, Relevant, Timely) criteria. Competing consortia worked 6 to 12 months in the bidding process, which continually refined the tender requirements as well as the tender responses.

3 Leistungs Consult and Enterprise Based Business Design Improvement

Leistungs Consult was involved in helping to define the management system part of the tender response. A-Lanes committed to designing their management system to fully meet the ISO 9001, ISO 14400 and ISO 15288 standards. Leistungs Consult ran workshops with the A-Lanes tender team, which would become part of the core A-15 project management team. Initially the workshops focused on explaining what the ISO 15288 system lifecycle standard meant, and then how it could be applied to the construction industry. For many of the participants this was their first introduction to such a standard, so their level of understanding was low.

Leistungs Consult then worked with A-Lanes persons to define the overall shape and application of the standard to the proposed A-Lanes management system. Due to the nature of the contract, which covers design, build, finance and maintain (so-called DBFM contract), A-Lanes consortia decided to set up 3 companies, one for design, one for construction and one for maintenance. The advantage of this structure is that each company only needs to exist for a specific time, e.g. the design company needs to operate for 4 years, while the maintenance company needs to operate for 20 years, as they will maintain the highway once it is constructed.

The next workshop focused on tailoring the generic process descriptions in the ISO 15288 standard into activities and work products that had real meaning and application for construction industry work. It was agreed to follow Leistung Consult's Enterprise Based Business Design Improvement (EBBDI) method to tailor and deliver the process descriptions and process implementation plans. EBBDI is a design first approach that takes into account the need to later perform process assessment using ISO 15504. This was combined with creating target process profiles using Practical Process Profiles that focussed on reducing risk for A-Lanes and Rijkswaterstaat.

A-Lanes implemented all the required processes within the contract mobilization phase, well ahead of schedule. There has been continual training as the project team ramp-up occurs, with new staff being trained on a regular basis. The team is growing from the 15 core team members to over 300 persons in a period of little over a year.

4 EBBDI Tailoring: Integration and Implementation Process Examples

A-Lanes is the overall engineering company. It designs and specifies how construction work will be performed, but does not do the construction work. The construction work will be contracted using a limited competitive tendering approach among the consortium partners. Therefore the way ISO 15288 specifies the implementation process does not apply per se to A-Lanes. Using EBBDI, this process was tailored together with the Integration process to create a combined project and industry specific process. The process has three main instantiations, one for civil construction (e.g. tunnels, etc.), one for the road construction and one for traffic installations (e.g. signalling, etc.).

To highlight some of the unusual aspects of implementation that a construction industry company faces, one of the process activities includes the removal of bombs found at the work site. Due to the nature of the terrain, which is very soft ground and in places marshy. It is not unusual to find unexploded bombs from the Second World War buried in various parts of the highway corridor. Already one bomb has been unearthed by backhoe. There are specific procedures for disarming and removing bombs, using specialist personnel.

To minimize the possibility of accident due to unexploded bombs, part of the stakeholder requirements definition process includes reaching out to local communities, and particularly older citizens who may remember where bombs dropped. This has already successfully identified and located another two unexploded bombs.

Integration activities include the coordination of the three main work streams, namely roads, civil and traffic installations, as well as coordination with the industrial stakeholder works. For example there are literally hundreds of cable and pipe corridors between port facilities and users such as the Shell refinery. When these adjoin or cross the highway corridor, there needs to be specific integration activities to ensure the corridor constructions are usable ‘as is’ or moved if needed. Naturally these cannot be damaged or simply ignored as they are usually in operation, so any change requires specific coordination with the affected stakeholders during the construction phases.

5 Example of EBBDI Tailoring: Maintenance Process

The maintenance process takes into account various types of planned highway maintenance, including regular and heavy maintenance. Heavy maintenance is an

activity where part of the highway would be closed for a longer period of time, for example in order to re-lay the road surface. Regular maintenance includes work like line marking, servicing of the thousands of electrical installations along the highway (e.g. road lighting, signalling systems, automated toll collection systems for trucks, etc.) and other work that do not require major road closure.

The maintenance process also needs to take into account the work environment – imagine working on the highway as trucks whizz by at 100 kmh! So safety of personnel is paramount. Other aspects include when to work without lane closures; how to divert traffic temporarily using lane closure and lane re-opening coordinated with signalling; getting maintenance vehicles, materials and personnel onsite; all while minimizing traffic disturbance.

The maintenance process will also perform a very significant quantity of measurements, both static and dynamic. Measurement includes the number of vehicles using the highway per day and the types of vehicles and loads; rate of wear on the road surface; using weighing stations on a temporary basis; as well as sophisticated measurement approaches like dynamic weight measurement of trucks travelling on the highway with related road deflection measurement. This latter measurement requires data collection from various sources (e.g. stress sensors built into road structures) as well as remote sensing (e.g. laser tracking of truck movement).

There are contractual requirements on minimizing traffic disturbance, with penalties based upon aspects like traffic delays and reduced traffic capacity at peak versus slack times. It is therefore in A-Lanes interest to minimize traffic disturbance while not compromising safety of maintenance personnel. Based upon the goals of minimizing life cycle cost of maintenance and related risks to this goal, the EBBDI method identified specific activities for the maintenance process and combined with use of Practical Process Profiles specified the required process capability level.

6 Summary and Results

Using the Enterprise Based Business Design Improvement method from Leistungs Consult has allowed A-Lanes to define a management system suitable for a construction industry company and fully meet the requirements of ISO 15288. The method has also allowed A-Lanes to incorporate best practice solutions to project specific challenges (e.g. bomb removal). The ability of A-Lanes to put a management system in place early in the life time of the project has been positively received by the client. A-Lanes are already reaping the rewards of their pro-active definition of the management system in terms of lower risk and the ability to bring new people into the project with a minimum of disturbance and training. Specific process owners are finding that following the process is more efficient and effective than the usual construction industry approach, hence they are seeing savings already, even in the early phases of the project. In particular the maintenance process owner has recognized greater potential for savings in maintenance through using the tailored maintenance process in the design phase of the project.