Value Management – achieving the impossible on time

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Abstract:
This paper would also be at home at an engineering conference because it uses, as an example, the relocation by public road, of an historic 95 tonne, brick school building. Some of the complex engineering problems are explained but although the achievement was significant from an engineering perspective, its success depended more on the bringing together of enabling resources to produce a team effort. This was achieved using facilitated value management techniques with key stakeholders to quickly establish required outcomes and identify the best value way of achieving them. VM principles were used with powerful effect to fast track an achievement that was thought by experts to be impossible. The paper emphasises the use of value management techniques to bring a wide range of stakeholders and volunteers together to manage a crisis and solve a complex set of problems within an impossibly short time frame. Function analysis, creative thinking, development and selection of options were all important in addressing the need to get it right - the first and only time. The paper deals with a feat of engineering that had never been successfully achieved in Australia or, as far as can be ascertained, in the World. It is concluded the use of value management tools and techniques not only add value but also increase the chances of success for high-risk projects such as this.

Key words:
Enabling resources, community support, stakeholder commitment, getting it right first time, function analysis, value management, crisis management.

Introduction

Clients rightly expect Value Management (VM) and Value Engineering (VE) to add value and generally expect to get more functionality for the same or less cost. To identify costs and hence savings, a project must have reached an appropriate level of development - usually part way through design development.

However, the absence of reliable cost estimates need not limit the application of VM to achieve significant project benefits.

Important benefits can be achieved through increased communication, commitment to project purpose, team building, reduced rework, getting it right first time and developing risk and crisis management procedures. These and other benefits of VM are available at any time in the life of a project.

This paper addresses the case of a project that had very high community and stakeholder support but at the 11th hour a lack of key essential resources meant almost certain abandonment. If this were to happen, costs would be expended but the project objective would not be achieved; thus a very poor value outcome would be the result.

In 1987, VM was just emerging as a respected problem solving and value adding method in Australia. Based on facilitated stakeholder participation, function analysis, lateral thinking and innovation, VM seemed an appropriate tool to reaffirm this project's objective and to look for alternative ways of making it happen. VM tools were used to effectively solve problems as they arose, normalise the crisis at hand and turn the project around to be an outstanding success.

Although a small, low cost community project, its success has fostered interest in Australia and around the World.

Background

Armadale is a pleasant village community with a population of 54,000 and located approximately 30km south of Perth in Western Australia (WA).

The original Armadale Primary School was built in 1900. The building has double brick cavity walls laid in lime mortar and the roof is framed in West Australian Jarrah timber, as are the floor and floorboards. Construction was typical of the time due to the abundance of these materials; the building is approximately 11m long, 9m wide and 8m high.

Generations of Armadale people had their formative schooling in this building and had developed a strong attachment to the school - the original building symbolised their attachment. In 1987 when a new school was built and the old site sold to allow a new supermarket to be built, a dedicated group of local people took on the commitment to save the old building.

Also to be bulldozed was the old congregational church, which was located opposite the school. The Armadale School and Congregational Church Relocation Trust was formed to save both buildings and have them relocated to Minnawarra Park, which is about 1.5 km away.

Money was raised, sufficient for demolishing the church brick by brick with each component carefully marked so that it could be re-built in an authentic way. However, the process of demolishing the church and preparing it for rebuilding on a new site was time consuming and expensive.

When the time came to consider the school there was insufficient funding to allow it to be relocated in the same way but more importantly there was not enough time. The fallback plan was to try to relocate the building in one piece by using a complex system of jacks to raise it onto a suitable truck but the necessary jacks were not available. Moreover, there was little understanding of the engineering problems to be faced in lifting and transporting a building of this type in one piece.

Demolition of the school was scheduled to take place in just a little over two weeks time so with lack of time, lack of money and no jacks for lifting the building in one piece, a crisis was at hand for the Trust.

Understanding the problem situation

The Trust manager set up a crisis meeting and invited all key stakeholders. Principle of which were the project manager, key supporters in money and other resources, the local authority and the designers of the intended new site and facilities. The Trust manager and other stakeholders explained that there was no time or money to relocate the school building in the same way as the church had been. The meeting heard that consideration had been given to raising the building using a set of jacks so that it could be set down on a truck and transported to its new site; however, the necessary jacks were not available.

The trust had also approached the West Australian State Government for assistance and they sent along a structural engineer who happened to have an interest in VM. He saw the use of VM tools as an appropriate method to determine if an alternative means could be found to deliver the project objective.

As time was about to run out, it was clear that if the building was to be removed from the site and saved, then the only option was to relocate it in one piece. This had been done before with brick buildings by utilising multiple jacking systems. Generally the building was moved on rails and in a straight line over short distances. This method took time this project did not have since the jacking process and the journey needed to be taken very slowly to avoid damage.

The meeting heard that because the bricks were laid in lime mortar, they were very weak and even small movements could cause significant cracking and probable collapse. If an attempt were to be made to move the building in one piece then it would have to be temporarily strengthened.

Adding to the problems of moving the building without collapse was the knowledge that the walls were not of uniform mass. Both end walls were solid but the side walls were very different. One sidewall had six almost full height windows; the other was solid with a doorway, a chimney and fireplace. Hence, determining the centre of mass for individual elements and the building as a whole required time consuming investigation and calculations.

On the plus side, there was a very high level of commitment to the project from the local community and from key contributors. The enabling resources that had been promised included: heavy-duty transport and earthmoving equipment, materials, cranes, labour and specialised services such as welding.

Analysing the purpose

The key output function was agreed to be "relocate the school building". The "how to do this" in the time available presented the problem to be solved.

It was clear that if the project was to succeed in the time available then the only answer to "how it could be achieved" was: "lift the building in one piece, place it on a vehicle, transport the building by road approximately 1.5km, lift the building off the vehicle and place it onto new foundations at the new site". As far as could be determined there were no previous success stories for relocating brick buildings without the use of jacks and rails – at least in Australia.

It was resolved that the meeting should adjourn overnight so the structural engineer could consider if an alternative way of lifting and transporting the building could be found. All participants were asked to reassess the resources, consider the time available and use their lateral thinking powers to develop ideas that could rescue the project.

It was agreed that if a solution could be found it would likely involve the use of new, unproven methods and therefore entail a level of risk.

Proposals

When the meeting resumed, ideas that may make the project possible were sought from all stakeholders.

The engineer had developed a proposal he felt could allow the building to be successfully relocated in one piece. His method involved the use of four, 50 tonne cranes and a powerful low loader capable of transporting several hundred tonnes along a public road. In addition the engineer proposed several wall strengthening measures and a prestressed steel platform to support the old building as it was lifted off its existing foundations.

For this method to work it would mean that all enabling resources would have to be marshalled to follow a coordinated process, provide their services on time and work to very fine tolerances.

Facilitated problem solving using VM methods would be needed to keep stakeholders focussed and responsive during the two weeks that were available for the work to be carried out.

A timely decision

The stakeholder meeting agreed that the only method likely to succeed in the time available was that proposed by the engineer, i.e. to raise and lower the building by cranes and use a suitable truck to transport it.

All of the required enabling resources were checked for availability and found to be adequate. A program of work and resources was suggested which would be monitored and managed every day by the hour. The structural design effort and the building modifications required by the engineer would become the critical tasks. A risk assessment was also carried out so that potential problems could be highlighted in advance and given special prominence in the work program.

Identified risks included: incorrect assumptions and calculations, inappropriate or inadequate equipment, poor workmanship and event dependent issues such as the lifting process, the initial movement off site, uneven roadways, unnecessary stresses and general access.

The proposed method was given little chance of success by most engineering authorities and stakeholders acknowledged there was a high risk that the old building could collapse during the lifting and transportation process. Even so, the decision was made that the proposal should proceed.

The engineering problem – simply put

The structural engineer was faced with a complex problem of many dimensions including:

- Brick walls laid in weak lime mortar;
- The mass to be lifted was considerable;
- The building was considered brittle;
- Deflection had to be minimised;

- The mass to be lifted was unevenly distributed;

and in addition;

- Lifting the building would impose a different set of stresses and support reactions to those imposed when the building would be set down on the truck and different again to when the building was set down onto new foundations.

The structural solution required the construction of a lifting platform underneath the building. This comprised a grillage of steel beams that were pre-stressed and pre-cambered to become flat precisely as the full load was transferred from the foundations to the cranes.

However, other dynamic and inertia forces would come into play as soon as the building began its journey by road, including starting and stopping and undulations in the road surface.

To support the walls laterally, a light steel frame was constructed inside the building and attached to the supporting steel grillage.

The building was almost three times as wide as the truck that would transport it and so two massive steel beams had to be welded to the truck to provide the right support in the right places to prevent the building collapsing when it was set down on the truck.

To maximise the chances of success the engineer aimed for construction tolerances and deflection of steel supports of less than 1mm.

Preparing for success

The Trust realised that if the project was to succeed then time and accuracy were the essence. Only two weeks were available before bulldozers moved in to clear the site for the new shopping centre.

Almost continuous collaboration occurred between the stakeholders responsible for key milestones. Whiteboard brainstorming and problem solving techniques were used to develop the most effective solution to "roadblocks" or crises.

Crises were overcome by workshopping the issues, with key stakeholders considering emerging risks and choosing solutions that were functionally appropriate and able to be achieved in the time available. Without this continuous sharing of information and resolution of issues the project would not have succeeded.

The team that carried out the modifications met frequently to make sure that critical path items were on schedule. An ongoing update on changes that would affect others was required and compliance with the engineer's design had to be reinforced on an hourly basis, as lack of time did not permit any rework.

Making it happen

Modifications and preparations for the relocation were achieved on time and the engineer gave the go-ahead for the building to be lifted. It was planned to lift it and place it on the truck late one day and move it to the new site early the next day (Sunday) to avoid traffic. The following Monday was the day the site was to be turned over to its new owners.

Before the building could be lifted and moved, stakeholders met to work through the procedure, function by function. New stakeholders had joined the team for the move including the electricity authority and police to clear hazards and facilitate transportation.

Workshopping of the relocation procedure assisted stakeholders to determine what they had to do and how they would achieve it in a way that facilitated the responsibilities of others.

A final risk assessment was made and issues that could impact on the project's success were given special consideration – including the safety of people.

The lifting took place on schedule. Four 50 tonne cranes were brought into position and connected to the lifting rig. As the cranes took up the load, careful attention was paid to the planned crack that would open between the building and its old foundations.

The engineer's calculations were proved correct. The building lifted off at precisely the predicted load and the separating cracks

remained even in width as the pre-stressed steel grillage deflected under the increasing load.
The building was raised high enough for the truck to be backed underneath. It was then set down on the truck and secured to wait out the night.

Next morning the truck moved the building to its new site where it was lifted off and placed onto new foundations.

Why VM techniques were important
Prior to VM being employed it appeared the project was doomed to failure. In addition, although the Trust and the local community were committed, expert opinion was divided as to whether a brittle brick building could be relocated successfully in one piece.

For the champions of the project and the Trust, the realisation of these facts presented a crisis.

VM allowed the rapid sharing and analysis of information and assisted stakeholders to sort facts from assumptions.

Function analysis was used in a group situation to reaffirm project objectives and facilitate suggestions for alternative ways of achieving the project's objectives.

VM techniques encouraged ideas and commitment from team members; both for the project and for the work they were responsible for. The latter being extremely important to following trades and to the overall success of the project, as everything had to be right first time.

VM techniques were used to build teamwork and a commitment to solve problems and overcome crises as they arose. In this way it was fundamental to the success of the project.

Conclusion
Generally speaking, clients expect VM to add value by saving cost or; by achieving additional functionality at the same cost or; proportionally greater functionality for additional cost.

However, experienced practitioners argue that VM offers greater benefits that cannot readily be assessed in cost terms.

The project outlined in this paper illustrates this view. The problem situation involved a crisis that threatened the viability of the project and no clear way forward could be seen. No amount of money could resolve it in time.

VM provided the necessary methodology and framework for stakeholders and participants to share skills and information and develop a workable solution to the crisis. The success of VM in achieving a very high level of teamwork meant this project was given the best chance of success.

Improved communication, teamwork and getting things right first time benefit all projects. For those where a crisis or new direction requires the use of new untried methods then VM is capable of adding great value to outcomes but the improvement may not easily be expressed in terms of cost.

The project outlined in this paper illustrates a situation where VM methods were used to assist stakeholders to overcome a crisis and made the difference between success and failure. What value would the Armadale community and the project champions put on this outcome?

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