VISIONS IN PLANNING TUNNELS & UNDERGROUND SPACE

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Planning of tunnels and underground space can now be bold and visionary because new technology will develop during and after the planning stages that will positively affect the feasibility of the project. Technology is now developing at such a fast rate that planners and decision makers have both great opportunities and challenges.

Big infrastructure projects such as transportation, water & wastewater systems and other major underground projects are generally planned 1 or 2 decades ahead. Moreover, the serviceable life of many tunnels is often over one century. These issues create a great challenge to planners and decision makers and illustrate the great importance of careful but creative vision during planning of these long-term projects. Planners must consider not only lessons learned from the past but also what new concepts and innovations may develop over an extremely long time.

In the future, most of the world's population will live, not in rural areas, but in urban cities. By October, 1999, about ½ of the 6 Billion people lived in urban areas. Planners and decision makers must realize that an enormous amount of infrastructure must be constructed not just for the very large megacities to be sustainable, but just for them just to survive. In fact, there may not be enough tunnellers to safely construct and operate such a large number of tunnels in such a short time. Fortunately for the underground industry, if the environment and sustainable development are considered, the underground is often the construction method of choice for much of the infrastructure.

The development of tunnelling technology was very slow from 1850 to almost 1950 because the vision of our forefathers exceeded the pace of technology. They were ahead of their time.

After about 1950, technology started to catch up with our vision and many of our forefather's ideas became reality. The message to the planners and designers is that our industry is very creative and can overcome any challenge. Thus, planners can and should be bold and daring in the planning of projects.

In the 1950s and 1960s, planners did not have many of the advances that we now enjoy (2006). Planners of this era did not even have TBMs to consider. Think what planners could have done if they knew that these tools would exist when their tunnel was finally constructed.

Systematic risk management procedures must be done as early as possible in the stages of a project (pre-conceptual or idea stage). The risks to be considered should be broad and also include risks of cost, schedule, environment, public acceptance, adjacent owners & third-party intervention, politics, etc. in addition to the technical risks that always immediately come to mind. Fortunately, the same concepts and tools can be used to identify value engineering ideas, as well as to identify broad ideas and opportunities (including "thinking out of the box").

Tunnels often remain in service for over a century. Accordingly, decisions about whether a certain infrastructure should be a tunnel, or not, should be made on considerations of Life-Cycle Cost, not Initial Capital Cost. Finally, using principles similar to those used in Risk Management, the likely cost of a tunnel or underground facility and also its planning and construction schedule should be developed and reported as a range, not as a single number. Obviously, the life-cycle costs should include future operational and maintenance costs. However, the cost analyses should also include realistic allowances for equivalent financial benefits from environmental and social improvements associated with tunnels.

There are many innovative tunnel concepts that have evolved because the project planners were highly creative and "thought out of the box." These include the A86 road tunnel project in Paris. By changing the rules and requiring all vehicles that use one of their tunnels be less than 2-m-high, the owner/concessionaire is able to fit 4 lanes of traffic plus 2 breakdown lanes (in a double-deck configuration) in a 11.6 m-outside-diameter tunnel.

Another innovative concept is the SMART tunnel project in Kuala Lumpur. This double-deck tunnel is specially configured to handle both auto traffic and floodwater. During low and medium flows, water flows beneath the lower deck while cars are still travelling through the tunnel. However, when a very big flood occurs, cars are removed and the flood waters are passed through the entire tunnel including the roadway.

In Seattle, a 50-year-old viaduct which follows the waterfront was damaged by an earthquake and needs replacing. A new structure is being considered to replace both the viaduct and the seawall with one structure with an overall savings in cost, schedule, and reduced disruption to the public. Moreover, the cost would be shared by both road and waterfront authorities.

There are some concepts being considered which now seem very bold. The Swiss Metro is a bold concept developed for a very high speed maglev transportation network in Switzerland which has been extended conceptually to other parts of Europe. A comparable scheme for North America, the AmericanMetro, has been proposed.

All of the proposed long ocean tunnels in the planning stage now (2006) fall into the category of visionary and bold tunnels as was the Channel Tunnel for over a century. Like the Channel Tunnel, the author believes that technology will be developed to make the tunnels currently in the planning stage feasible as well.

Finally, a Submerged Floating Tunnel (SFT) has been identified by the Discovery Channel as one idea for a crossing of very large body of water or maybe even an ocean. Such a concept has many non-technical obstacles which may prevent such a project to get farther than the conceptual stage. However, SFT engineers have identified the major issues to address to make such a concept work from a technical standpoint.

The author admits that some of these concepts may seem outrageous at the present time. However, the first three projects listed above either are in planning and construction or are already built.

There are many issues and events outside of our industry that will have a significant impact on our planning for tunnels. There is a now a greater chance that the world will need other fuels, possibly to include hydrogen fuel cells or a hybrid and planners should think of what effect it would have on the design of the ventilation system and the operation of the tunnels if it were to take place. Anther concept that may affect future tunnel planning is related to propulsion technology such as MagLev or other future propulsion breakthrough we don't even know about yet. Whether such a concept will be technically feasible or cost effective is yet to be seen, but consideration of such a concept for bold and daring planning of future tunnels may not be unreasonable

In conclusion, in past years, planners did not have the luxury of the many tools and techniques that exist today. We should be very proud of our forefathers who had great vision and whose ideas were not achieved in their lifetime. Technology development was so slow from about 1850 to 1950 that their ideas did not materialize until technology made their schemes feasible.

Now, technology is keeping up with our ideas and vision which can be implemented relatively quickly. Accordingly, planners should be aggressive and bold in their plans for tunnels.

Owners and planners should use risk management principles from the very first time a tunnel solution is considered and carry out systematic risk management evaluations throughout planning, design and construction. These same principles should be used to systematically develop and implement value engineering and new opportunities, especially those thinking out of the box. This is particularly true for long tunnels that have abundant uncertainties.

It should always be remembered that tunnels are an investment, not a cost. Owners should develop ways to account for a financial credit resulting from environmental advantages that accrue enormous environmental benefits to society. These environmental cost advantages should be incorporated into cost ranges that take into account the long service life of the tunnels by making the decision on Life Cycle Cost concepts, not initial capital cost.

The tunnel and underground industry is very creative and their ability to innovate has been proven many times. Owners and planners should have faith in the tunnel and underground industry. The industry will be up to any challenge so planners can plan boldly and with vision.