Adrian Mallory, University of Edinburgh

Can Engineers Make a Beneficial Contribution to Society?

Engineering the Greatest Medical Advance since 1840

The contributions of engineers to society can be seen through history with the markers that great engineering feats have left behind as a mark of different societies achievements: the great pyramids of Egypt, the great wall of China, the aqueducts of the Romans bringing clean water to cities population and many more engineering feats have left the high water mark of historical societies. In modern society great advances in infrastructure have brought huge medical and social benefits to the world with the development of roads, railways and water networks. These advances in infrastructure have contributed to the modern world's prosperity with greater trade and transport and lengthening life expectancy. As an indicator of the potential for engineers to improve society, readers of the British Medical Journal cited the development of sanitation as the greatest medical advance since 1840 (Ferriman, 2007). This essay will highlight the role that engineers play in providing vital infrastructure for sanitation where it is still lacking and the socio-economic and health benefits it brings.

Engineers' Role in Achieving the Millennium Development Goals (MDGs)

At the turn of the millennium, the UN worked to create a blueprint to which all countries and development institutions agreed to help the world's poorest people (U.N., 2014.a.). These will be used as a reference to understand the areas where engineers can provide benefits to the most vulnerable people in society. There are 3 goals in particular where a large role for engineers can be seen. The 1st MDG of eradicating extreme poverty and hunger can be linked to engineering through improved design in agriculture: simple things such as drip irrigation systems or solar water pumps can act as routes to improved agriculture. The 6th MDG of eradicating major diseases has the same challenge of infrastructure as mentioned in the introduction. When working on a project in Malawi there was a health clinic which had the medicine to treat malaria, but the surrounding rural areas had no roads meaning that someone would have to walk for hours to gain access to life saving medicine which caused the death of a local villager in the short time I was there. The MDG of focus here though is number 7: Ensuring Environmental Sustainability which includes halving the amount of people without access to water and sanitation by 2015.

Engineers' Role in Providing Sanitation

Great efforts through the early millennium have resulted in the proportion of people without access to water being reduced from 24 to 11 per cent, achieving the target of halving the proportion by 2010 (UN, 2014.b.). Providing 2.3 billion people with an improved drinking water source since 1990 has to be one of the great achievements of society development, and shows the impact infrastructure and engineering can have on society. There has been less success in providing improved sanitation to the population with the proportion with access increasing from 49% to 64% leaving 2 billion people still without adequate sanitation. This failure has implications for improved water sources and diseases in society. Providing safe sanitation is a challenge for the post MDG world of society development that engineers will have a major role in.

Developed nations have built nearly universal safe sanitation through extensive sewerage systems that carry away waste safely protecting the health of people. Trying to replicate a network like this is fraught with difficulties that require engineers to look beyond these systems to provide health and protection to the population. Firstly, providing sewers is a very expensive method of disposal and the costs are even hitting richer countries, with Jefferson County, Alabama filing for the largest ever municipal bankruptcy in 2011 from the costs of new sewers (The Economist, 2011). The requirements of large volumes of water can also be highly demanding in water scarce regions like Sub-Saharan Africa, the region with lowest sanitation coverage. These factors lead to sewerage only being provided in the wealthier areas and centres of African cities (Isoke & Van Dijk, 2014). In dense unplanned urban areas, with lower incomes, there is a requirement for different types of design for sanitation that suit the local context which is the role of engineers.

There has been an effort to move beyond the model of subsidized sewer systems and towards more sustainable systems to provide long term health and financial benefits. There has been a large effort focusing in providing sanitation in dense unplanned urban areas that are common in low-income countries, and usually don't have access to government services which actually ends with the poorest paying more for services like water and sanitation (Budinich, 2005). In place of government and utility provision, an informal network of providers exists to supply the demand for building infrastructure and services like latrine emptying. As people in these areas already pay for substandard services, there is potential to build a sustainable business in providing sanitation as well as all the associated health benefits. The huge challenge currently is that the existing model doesn't encourage safe treatment and disposal, meaning that the socio-economic and health benefits are lost. There are various examples showing that the model where customers pay for removal isn't sufficient to cover the costs of transporting waste to a treatment works and then the dumping fee also included (Kome, 2011) (Schaub-Jones, 2012). This results in illegal dumping of waste meaning that the health of communities is still at risk from contamination.

Engineering solutions are beginning to change this reality and have the potential to encourage safe treatment of waste in poor areas, providing protection. This has been achieved through the design of treatment processes that harness value from the waste either through producing fertilizer or biogas for energy making treatment a financially sustainable option. This model where treatment is funded through recovering value means that there will be less need to charge the network of providers collecting waste, and potentially pay them, to bring the waste for safe disposal. Water for People have done work in this area through working to produce fertilizer from sanitation systems, providing improved income for people working in sanitation whilst farmers can get cheaper agriculture products than using artificial fertilizer (Water for People, 2013). A similar model to this was practiced by the NGO Peepoople, where in an effort to improve upon open defecation, still practiced by billions of people, a business sells self-sanitizing bags which can be affixed to containers or toilets and then digest into compost over 3-4 weeks (Hystra, 2014). This compost is again sold to farmers at a cheaper rate than chemical fertilizer. These new technological treatment processes can potentially create a market where there is a positive incentive not only to collect waste from communities, but to treat it effectively and provide useful by-products.

How Providing Improved Sanitation Contributes to Society

This essay has aimed to demonstrate the role that engineers have in improving society through focusing on a very specific singular goal of the Millennium Development Goals and how engineers

can help to achieve the aims beyond 2015. Taking a look at the work that has provided more sustainable sanitation to communities in Sub-Saharan Africa, they actually have benefits far beyond the singular aim of improving sanitation. Through making the sanitation providers a sustainable business in urban areas not serviced by utilities, there is an extra generated income for people in communities, which contributes to reducing extreme poverty. The business models also produce fertilizer products for sustainable fertilizer which contribute to providing food security and environmental sustainability by using natural products instead of chemicals. There is a common problem with poor sanitation and odours attracting mosquitos and the associated health risks, so improving sanitation will reduce the risk of disease transmission from such vectors. Finally there is the overall benefit of protecting water sources and having a cleaner environment protecting people from illness. So overall even in a very specific area of public services there is the potential for engineers and good design to contribute to society on a much wider scale as shown in these sanitation models which actually contribute to achieving the 3 original Millennium Development Goals cited as influenced by engineers and pointing some of the poorest societies towards an improved, sustainable future.