Water Conservation on Cruise Ships - Induced Behavioural Change Through Adjustments in Water Temperature

This proposal was developed as part of the Global Sustainable Entrepreneurship class during my study abroad term on [Semester at Sea's Spring 2014 voyage](). The objective was to develop a strategy to reduce water consumption on the ship to augment the MV Explorer's "Pathway to Sustainability Initiative".

Objective

The objective of this project is to develop a strategy to reduce the environmental footprint of a 25,000-ton, 850-passenger cruise ship through reductions in water consumption. The proposal is subject to two conditions: (1) implementation must be possible under a $500 budget constraint, and (2) the solution must be ready to implement immediately without additional resources not currently available on the ship.

Proposed Solution

The proposed solution is to reduce the temperature of hot water allocated to showers in passenger cabins, in order to reduce the average shower time for each passenger. The solution is predicated on a hypothesis that shower duration is a function of water temperature, which influences shower time by increasing or decreasing comfort. This idea was developed by: (1) establishing a series of assumptions, which were then validated to constrain the problem space and identify a specific focus area; (2) further analyzing this focus area to determine the levers of highest potential impact; and (3) designing a testing methodology to confirm the solution hypothesis.

First, our problem scope was constrained to the behavioural component of shower duration through a series of assumptions. We began by segmenting the contributing factors of water consumption on a ship into branches, grouping them into two primary categories of behavioural and technical factors. We then decided to limit the scope of our analysis to behavioural factors only, under the assumption that the ship's management had likely minimized operating costs already by optimizing water consumption from a technical or engineering standpoint. We then conducted interviews with the ship's engineers and administrators, through which we discovered that the largest source of water consumption were bathrooms in passenger cabins. Within the bathroom we identified the points of water consumption to be the sink, the toilet, and the shower.

We decided to focus our attention on showers as duration of use is the primary contributing factor to water volume at this point of consumption. Further, because shower duration is a behavioural factor, we felt it could be effectively managed within our budget constraints. To better understand and validate this assumption we conducted a series of interviews with passengers, through which we came to believe that the defining behavioural factor in shower duration was comfort. Our hypothesis was that shower duration is a function of water temperature, which influences shower time by increasing or decreasing comfort. Put simply, the warmer the water, the more comfortable it is to take a longer shower.

We then further observed that for longer showers, the sum of the time spent on pure-utility functions such as lathering, brushing, and rinsing, did not constitute the entire duration of the shower. Rather, we determined that there is some "idle time" during which the passenger is simply standing in the shower for enjoyment rather than utility. Therefore, if we are able to reduce a 10-minute shower to a 7-minute shower by eliminating this idle time, we would be able to reduce water consumption by a significant amount when taking into account the multiplying effect of 850 passengers on board.

Given the assumptions that: (1) Shower duration is a function of water temperature, and that (2) this relationship is consistent across all passenger demographics, we propose to reduce water consumption on the ship by lowering the heated water temperature at the shower head by a few degrees. The objective would be to maximize water conservation through reduction in shower duration, while minimizing discomfort arising from showering with a lower water temperature. The reduction in temperature would not affect any kitchen processes, as most culinary uses of hot water require boiled water rather than heated water directly drawn from the tap.

To test our theory, marginal reductions in hot water temperature of perhaps half a degree would be repeated over the course of the entire testing period until an optimum temperature is found. Water consumption volume would be monitored on a daily basis and any significant reduction over the period of each half-unit of reduction in temperature would be recorded. The effect of the reduction in water temperature would be isolated as much as possible from other confounding variables such as the voyage itinerary, weather, and non-recurring events that significantly depart from daily activities of passengers on board.

The ideal test duration could be around 30 days at sea for each half-unit reduction in temperature, to ensure adequate sample size and develop a baseline for each step decrease in temperature in order to eliminate outliers. A second and equally important element of our testing would be to closely track any complaints regarding water temperature for the duration of the testing phase. This second element aids us in determining the point at which the temperature differential becomes noticeable to the shipboard population. A regularly administered survey would also aid in tracking passenger comfort.

The optimal water temperature for passenger cabins would be found by determining the equilibrium temperature that maximizes both conservation and comfort. In an ideal scenario most passengers would either not notice or find discomfort in the slight temperature decrease, but still respond to the decrease by reducing their idle shower time. This approach allows for a naturally induced behavioural change by directly influencing the factors underlying the behaviour, rather than through an educational campaign in which the ultimate decision for behavioural change still remains a conscious decision for the passenger.

These marginal changes to water temperature can be made without any operational cost whatsoever, and in fact reduce costs in the long run through a decrease in energy consumption. While further research is needed to validate our hypothesis, we believe that the positive environmental impacts of our proposed solution in addition to the no-cost benefit, give reason for such research to take place. We strongly believe that it is possible to balance passenger comfort, water conservation, and operational costs to accrue maximum utility for all stakeholders, and we hope that our proposal will motivate further progress in this regard.