Design Standards and Travelling Facts: Lessons from the standardization of British wire sizes (c1880)

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Design standards help to transmit factual information regarding the object produced, such as information about its construction or composition, its quality, its expected performance, etc. All of these attributes help to determine the economic value of the object. The greater the consistency of the standard – or the compatibility between multiple standards used by different groups – the greater is the likelihood that facts about the object's value would travel well between different groups or geographies. The corollary to this is that inconsistent standards can act as a barrier in the transmission of economic facts, even if the standards themselves are highly precise. Although inappropriate under many circumstances, some groups may actually prefer inconsistency in standards. Thus, some groups may remain un-desirous of transmitting factual information i.e. making sure facts do not 'travel' well. Naturally, there may be some benefits of retaining design inconsistency in such cases.

Concomitant to the question of 'why achieve consistency' is the related one of 'how to achieve consistency'. Although, precise measurements may help in achieving consistency, that by itself may not be enough. Standards would need to be *accurate* in addition to being *precise*. The difference between precision and accuracy in effect depends upon how close the standard comes to representing the 'true value' of the object, as seen by different groups. Consistency, and the ability to transmit economic facts, depends upon the accuracy of the standards. Obtaining accuracy is a socially embedded process and is not merely technologically dependent.

These issues about the transmission of technical and economic facts is explored using the case of the standardization of British wire sizes from the late nineteenth century. Although much of the engineering revolution of the 19th century was based upon accurate measurements and standardized parts, achieving consistency of metal wire sizes frustrated efforts of engineers like Charles Holtzapffel, Joseph Whitworth and Latimer Clark. Holtzapffel proposed uniform wire sizes based on the decimal units of the inch in 1847. Whitworth proposed a scheme for standardizing wire sizes to the Institution of Mechanical Engineers in 1856 and in 1857. Clark read papers to the British Association (BA) in 1867 and 1869 outlining the problems of wire sizes faced by telegraph engineers and proposed a geometrical scale of wire sizes. None of these proposals appealed much to the industry, which continued to use multiple standards of wire sizes.

By the end of the 1870s, around 45 distinct wire gauges were in use in Britain alone. In 1878, the Birmingham Chamber of Commerce (BCC) initiated efforts to get the trade to agree on an industry standard. They in fact asked Whitworth to help them devise a standard scale. Around this time the Society of Telegraph Engineers (STE) resurrected Clark's original BA proposal. But by 1882 the industry seemed no closer to agreeing on uniform sizes for wires than before. The stalemate between the industry associations and the dominant manufacturers was not resolved until the Board of Trade became involved in the negotiations to set an industry standard.

The English wire manufacturers, who were facing intense competition from the Germans in their domestic as well as international markets, were opposed to the sizes proposed by both the STE as well as the BCC from the beginning. They had proposed a rival scheme, claiming it was based on the practical methods of wire manufacturing. The legal wire gauge that emerged in 1883 was a negotiated outcome between the STE, BCC and the manufacturers - with the Board of Trade acting as an arbitrator in this dispute. The system of measurements adopted was very different from those proposed by Clark and Whitworth. Although, measurements were based on the decimal units of the inch (rather than the fractional units traditionally used), the standard was derived from 'empirical sizes' and was not from some abstract scientific principles; indeed, engineers and manufacturers disputed the very basis of scientific rationality in this context.

This case explores how scientific rationality could be at odds with economic rationality. Accuracy is as much dependant upon the latter as that on the former notion of rationality. The paper explores the case of metal wires in order to provide an explanation of why and how a consistent design emerged in 1883: an outcome of intense negotiations between various industry associations, engineering societies and the Board of Trade. The focus is on explaining why the industry rejected the 'scientific' basis of organizing wire sizes and preferred the 'empirical' basis. In so doing, the paper explores how a consistent design standard emerged in c1883. The paper also investigates the extent to which science could aid in the transmission of facts by making designs consistent, that is, to what extent it could help to make the wire sizes *accurate* as well as *precise*.