

# Frank and Lillian Gilbreth: scientific management in the operating room

A Baumgart,<sup>1</sup> D Neuhauser<sup>2</sup>

<sup>1</sup> The Medical Faculty Mannheim, University of Heidelberg, Heidelberg, Germany; <sup>2</sup> Department of Epidemiology and Biostatistics, Medical School, Case Western Reserve University, Cleveland, Ohio, USA

Correspondence to: Duncan Neuhauser, Department of Epidemiology and Biostatistics, Medical School, Case Western Reserve University, 10900 Euclid Ave, Cleveland, OH 44106-4945, USA; [dvn@case.edu](mailto:dvn@case.edu)

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The advent of scientific management in operating rooms at the beginning of the 20th century was a part of the long history of applications of management methods and principles in healthcare. Early pioneers in this field were Frank and Lillian Gilbreth. The Gilbreths' primary focus was on work performance and worker satisfaction. They conducted pioneering research in the fields of time and motion study. This covered the lifelong search for "The One Best Way" in organising and executing work flows and processes.<sup>1 2</sup>

## SCIENTIFIC MANAGEMENT

Scientific management was a development of the 1880s and 1890s and is most closely associated with Frederick W. Taylor (1856–1915) whose Time Study method defined the field.<sup>3 4</sup> His favourite example of this approach was observing the work of 75 men at the Bethlehem Steel Company who moved pig iron by shovel all day. After a careful analysis of this hard repetitive work, Taylor's engineers decided that great improvements in productivity could be achieved. One worker was carefully selected and asked to change the way he worked by following the engineer's directions exactly. "We want no back talk... When he tells you to walk, you walk, when he tells you to sit down, you sit down." As a result, this worker raised his productivity from 12.5 to 47 tons of pig iron moved per day. The worker, who was paid piece rate, thereby increased his pay from \$1.15 to \$1.85 per day.<sup>5</sup> Taylor's approach also included the redesign of the equipment, such as the size and shape of the shovels in use. In another project at this mill, he changed the temperature of steel when it was cut, allowing for greater processing speed and substantial savings.<sup>5</sup>

## INTRODUCTION

In 1907, Frank Gilbreth became a disciple of the Taylor system and his wife Lillian became an active partner in their scientific management research.<sup>2</sup> The Gilbreths played an ambivalent role in relation to the Taylor system.<sup>6 7</sup> Both were promoters of Taylor but at the same time competitors due to their different perspectives on work and workers. Taylor focused on "time" and the Gilbreths on "motion", although both would have seen this as a great oversimplification of the breadth of their work and vision.

Frank Gilbreth was a successful building contractor in Providence Rhode Island. Before he had read about Taylor's work, he redesigned the repetitive task of brick laying by reducing the motions for each brick laid from 18 to 4.5 so that the worker's productivity went from 120 to 350

## Box 1 Surgical time and motion

Remember seeing those elegantly lined up surgical instruments at the start of an operation with the surgical nurse ready to hand the right instrument at the right moment to the surgeon.

Where did that idea and practice come from?

bricks laid per hour.<sup>3</sup> Gilbreth left his construction business to be a management consultant in 1912. He replaced Taylor's stopwatch with the movie camera<sup>7</sup> and promoted orthodox scientific management principles such as the re-organisation and improvements of the routing of work, introduction of planning departments and cost accounting. The Gilbreths developed a new technique, named micromotion study.<sup>8–10</sup> It consisted in part of filming the details of a worker's activities and motions while recording the time. The films mainly served two purposes. One was the visual record of how the work had been done. By studying these films, the Gilbreths (and their team) saw many ways to make improvements. The films also served the purpose of training workers about the best way to perform their work processes. Hence, the Gilbreths were able to compare methods and working conditions and present the results to workers and management. They could build on the best elements of these work flows to create a standardised best practice. Although motion study remained for Taylor subordinate to the time study, the attention he paid to it demonstrated the seriousness with which he considered the Gilbreths' approach.<sup>6</sup>

In 1914, the Gilbreths broke with Taylor and formed their own version of scientific management.<sup>2 11</sup> Lillian completed her PhD in psychology in 1915.<sup>12</sup> She incorporated new ideas to improve worker satisfaction that would further improve the overall job performance and worker efficiency.<sup>13</sup> The Gilbreths created a classification of human motions. This classification could be used to microanalyse worker behaviour. They called their list of motions "Therbligs" (Gilbreth spelled backward postfixed by an "s"). The Therbligs divided all work motions into 16 categories.<sup>14 15</sup> They could be identified and plotted on simultaneous cycle motion charts. The charts displayed the parts of the body on the horizontal axis and the elapsed time on the vertical axis. The chart reflected each body part's motion over time producing a clear visualisation of the relationships between the Therbligs.<sup>6</sup> The vision of the Gilbreths was that if science could be used to create the "one right way"

## Heroes and martyrs

### Box 2 Stopwatch solution to best practice

Taylor's scientific management approach required the detailed analysis of work to find the shortest possible time for each job. The efficiency expert's use of the stopwatch came to symbolise this approach. Once the best methods were found, the worker, being paid piece rate, and desirous of more pay, would adopt the expert's advice, become more productive and earn more.

of doing tasks, then all such tasks should be standardised. This became part of the standardisation movement of the 1910s and 1920s in various fields.

### MOVIES IN THE OPERATING ROOM

After the publication of Taylor's works *The Principles of Scientific Management*<sup>4</sup> and Frank Gilbreth's *Motion Study*,<sup>16</sup> the Gilbreths started focusing on scientific management consulting in other industries. As they expanded the scope of their studies to other fields in their new professional environment, Lillian widened her influence within their time and motion studies. Her training in industrial psychology contributed significantly to a more nuanced view of human behaviour than Taylor's comparatively simplistic view of the worker motivation.

The standardisation efforts of the Gilbreths were manifested in their articles "Scientific Management in the Hospital" (1914, 1915)<sup>17 18</sup> and "Hospital Efficiency from the Standpoint of the Efficiency Expert" (1915).<sup>19</sup> They described improvement strategies for nurses. At that time, standardisation was sought in various areas such as hospital design, medical equipment or patient records. For example, Frank Gilbreth observed that surgical practices and instrumentation varied greatly throughout the country. He noted in 1916 that "surgeons could learn more about motion study, time study, waste elimination, and scientific management from the industries than the industries could learn from the hospitals".<sup>20</sup>

The Gilbreths also started promoting the adoption of management practices for operating rooms. By studying surgical operations, the Gilbreths monitored physicians and the way operating room procedures were organised and executed. Since 1910, the Gilbreths used movies to conduct motion studies in surgery. They analysed each movement by the surgeons to see if their work could be more efficient and therefore less fatiguing. By such detailed analysis of human motion, they could see ways of eliminating unnecessary activities. One of their conclusions was that operating room nurses could improve efficiency. The Gilbreths observed that surgeons spent more time searching for their instruments when operating than actually performing the operation.<sup>14 21 22</sup> The new method significantly reduced operation times, thereby improving the quality of care. In addition, the Gilbreths recommended that surgical instruments should be organised and laid out in regular and consistent patterns. The alignment of work of physicians and nurses played (and still plays) an important role in the efficiency of operating room processes.

Here is what Frank Gilbreth had to say at the annual meeting of the American Hospital Association in 1914.

"There are several concessions you must make at the outset before you can expect to do any valuable work in introducing the science of management into the hospitals. The first is you must submit to having accurate measurement applied to your present

methods and practices. The second concession that must be made is the willingness to allow a man not trained in surgery to apply the measurement and determine the resulting standard. We can show you pictures which illustrate plainly the fact that standardization such as used under scientific management is today practically unknown...especially in the operating room."<sup>17</sup>

Frank Gilbreth presented their results on surgical operations and the standardisation of techniques in operating rooms at the meeting of the American Medical Association in 1915. Their recommendations were first ignored by the medical establishment. In the 1930, the American Medical Association eventually accepted the Gilbreths' operating room procedures, recognising the value of motion study.

### CHEAPER BY THE DOZEN

Frank Gilbreth was born as the youngest of three children in 1868 in Fairfield, Maine. He passed the MIT entrance exams in summer 1885 but declined. Instead he became a bricklayer's assistant. In 1895, he founded his own company, which became famous for finishing projects early and under budget. Lillian Gilbreth was born in 1878 in Oakland, California. She was the oldest surviving daughter of nine children. Lillian graduated from high school with straight A's and entered the University of California in 1896. She was the first woman in the university's history to deliver a commencement address in 1900. In 1902, she earned a master's degree in literature. In 1903, Lillian and Frank met in Boston. They were introduced by Lillian's friend and Frank's cousin Minnie Bunker. Six months after their first meeting, they got engaged. Lillian and Frank married in the living room of her parents' house in Oakland, California. They agreed to have 12 children. After Frank's death in 1924, Lillian managed to send every child to college. Lillian earned a Ph.D. from Brown University in 1915. Her thesis was called "The Psychology of Management". She became a first female professor of Management at Purdue University in 1935. Lillian retired in 1968 and died in 1972 in Phoenix, Arizona.<sup>1 23</sup> There is an American postage stamp with her picture on it to commemorate her work. There is no stamp for Frank. Perhaps there should be a monument to the most successful husband and wife partnership and successful merger of family and work life in the history of quality improvement leadership.

Frank and Lillian Gilbreths' lives have been described in a 1948 book by Frank Gilbreth, Jr., and Ernestine Gilbreth Carey entitled *Cheaper by the Dozen*. The book showed that Frank's and Lillian's scientific management thinking carried over to their private lives. Their 12 children were assigned certain tasks in the household—for example, taking care for the younger brothers and sisters or daily housekeeping. The book furthermore entails the story of time and motion study in the private life of the Gilbreths and their 12 children. *Cheaper by the Dozen* was made into a 1950 motion picture starring Clifton Webb and Myrna Loy as Frank and Lillian Gilbreth. There were also movies called *Cheaper by the Dozen* in 2003 and *Cheaper by the Dozen 2* in 2005, starring comedians Steve Martin and Bonnie Hunt. Both movies have however no link to the original book other than describing family life with 12 children.

### QUALITY IMPROVEMENT'S DEBT TO SCIENTIFIC MANAGEMENT

A scientific approach, the redesign of work processes, measurement and the role of improvement experts are part of today's quality improvement methods. Nevertheless, there are some important differences. The piece rate payment of scientific

management was replaced with the idea that every one wants to do a good job, but system failures put up barriers that make work satisfaction difficult. The scientific management expert owned the process. For quality improvement, the workers own the process and the quality improvement expert acts as a coach and helper. Team work becomes central. The number of bricks or tons of pig iron as quantitative outcome measures are replaced with quality measures and a close understanding of the wishes of the customer.

After Frank's death, the Gilbreths' reputation grew constantly. Two factors favoured their growing reputation. First, Lillian started realigning and differentiating their work from the Taylor community in the 1920s and 1930s. She gave a distinctive character to their original methods while relying on the basic ideas of Frank. Second, technical innovations by the Kodak camera company made it more convenient to apply micromotion studies at reduced costs. Hence, time and motion study gained broader acceptance.<sup>6</sup>

Although the scientific management community gained wider acceptance between 1900 and 1940, the availability of cheap labour and the scarcity of financial resources during the great depression limited work in this area. Gradually, alternative and revised management science methods appeared, questioning the fundamental assumptions of scientific management. One of these ideas evolved out of the Hawthorne studies of Elton Mayo and associates, which emphasised the importance of worker group norms and the informal organisation of workers in defining worker productivity. After World War II, Lillian continued her time and motion study to the work environment of nurses in hospitals. Throughout the 1950 to 1990s, most of the works of time and motion studies were not recognised by the scientific community or practitioners. The ideas of Frank and Lillian Gilbreth have evolved into new fields, such as ergonomics.<sup>11–20</sup> Ernest Amory Codman, MD, was a promoter of outcomes management in patient care. Codman and Frank Gilbreth were friends. Gilbreth was one of the speakers at the notorious meeting of January 6, 1915, in Boston when Codman presented his end-result ideas and upset Boston's medical community by showing a cartoon which portrayed prominent Boston doctors being more interested in gold than in the end results of their care.<sup>24–25</sup> Codman linked process to outcome and Gilbreth emphasised standardisation. Their ideas fit together. Standardisation in healthcare now takes the form of best practice based on clinical evidence and most quality improvement work consists of making sure that best practice care, based on best outcomes, occurs each and every time. Gilbreth said: "The follow up system (of Codman) is believed to be scientific management. The follow up system is a very small portion of the problem. It bears about the same relation to scientific management as a shingle does to a house."<sup>17</sup>

As Frank Gilbreth noted in a talk before the American Hospital Association convention in 1914: "When your management becomes a science there will result greater efficiency in you as individuals and in the great work of the hospitals to which you devote your lives".<sup>17</sup>

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A Baumgart and D Neuhauser

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