

Analysing the thinking of F.W. Taylor using cognitive mapping

Pierre Cossette

Université du Québec à Montréal, Montreal, Québec, Canada

Keywords

Taylorism, Cognitive mapping, Computer software

Abstract

Although the ideas of F.W. Taylor have profoundly marked the twentieth century, they do not seem to have been understood in the same way by the people who have studied them. Aims to enrich our understanding of the ideas of this remarkable author. Proposes a graphic representation of Taylor's thinking in the form of a cognitive map. Then analyses the structure and content of the map using the Decision Explorer software package. Most of the concepts and links shown in the map were drawn from "Shop management", and the remainder were taken from *The Principles of Scientific Management*. The results highlight the relative importance of the concepts used by Taylor, the dimensions on which he more or less consciously structured his thinking, together with the characteristics of the concepts he considered basically as "explanations" or "consequences", and the more or less systemic or circular logic that guided him in the organization of his thinking. Discusses the limitations of the results and some future avenues for research.

Introduction

There is probably no other author in management science whose ideas have aroused as much interest as those of Frederick Winslow Taylor. His two main texts on the scientific organization of work were "Shop management" (published for the first time in 1903, in *Transactions. American Society of Mechanical Engineers* for the Society's conference in Saratoga, New Jersey) and *The Principles of Scientific Management* (published for the first time in 1911 by Taylor himself, and distributed free of charge to the members of the same society at their annual conference). Both were translated into several languages, often soon after first being published in English. The conferences and other scientific meetings on what is now generally known as "Taylorism" have never been listed, but there is no doubt as to either their large numbers or the interest they generate. Biographical works, such as those by Copley (1923), Kakar (1970), Nelson (1980), Wrege and Greenwood (1991) and, more recently, Kanigel (1997), show that the man and his ideas have profoundly marked the twentieth century. As regards texts (papers, books, etc.) devoted exclusively or partially to Taylor's thinking, they are quite simply impossible to count. Generally speaking, the vast majority of past and present authors in the organizational sciences, and especially in the field of organization theory, have thought it necessary to state their position with regard to one or more of the ideas attributed to Taylor. It is therefore hardly surprising to learn that, in a survey carried out by Wren and Hay (1977) among members of the Business History conference, the Management History division of the Academy of Management and a

representative sample of the members of the academy's other divisions, that Taylor was found to be the individual who had made the greatest contribution to the development of management thinking and practice.

Despite this undeniable influence, Taylorism is still somewhat ambiguous as a concept. Many well-known authors, including Drucker (1976) and Locke (1982), have said that Taylor's ideas have never been properly understood. Obviously, the people who read the ideas expressed by Taylor, including Taylor himself, were not struck by the same concepts or by the same links that he established between those concepts, or did not ascribe the same importance to them. This situation can certainly be attributed in part to the referential system of the individuals in question, and to Taylor's lack of talent as a writer. "Shop management", which contains the most complete formulation of Taylor's thinking, is a badly-structured text with no guiding thread, full of repetitions and imprecisions (Vatin, 1990; Kanigel, 1997; Nelson, 1980). Also, according to Wrege and Greenwood (1991), Sandford Thompson, who was one of Taylor's closest collaborators, sent Taylor, at his request, various reports, information and "notes" on the range of topics covered in "Shop management". They were clearly used by Taylor, sometimes becoming pages of the manuscript. (With regard to *The Principles of Scientific Management*, a much better written document, we know that Morris Cooke, another of Taylor's close collaborators, helped considerably in structuring Taylor's writing, to such an extent that Wrege and Stotka (1978) actually accused Taylor of plagiarism.)

It should be remembered that, until now, all the analysis (however explicit and systematic it may have been) of the work Taylor considered himself to have authored has been thematic and qualitative in nature. This type of approach has certainly helped understand Taylor's thinking, but it was also



Management Decision
40/2 [2002] 168-182

© MCB UP Limited
[ISSN 0025-1747]
[DOI 10.1108/00251740210422848]

The current issue and full text archive of this journal is available at
<http://www.emeraldinsight.com/0025-1747.htm>



particularly likely to produce very different, and even contradictory, interpretations. Clearly, other discourse analysis approaches would also have their limits, but by taking a different angle they may be able to highlight some specific aspects of Taylor's thinking that it would be difficult, if not impossible, to identify otherwise. New approaches could also add to or detract from the credibility of some existing interpretations of Taylor's observations.

This research is intended to do precisely this. Its aim is to present a graphic representation, in the form of a cognitive map, of Taylor's cognitive structure as it emerges from his two main texts, and to analyse the resulting semantic network using the Decision Explorer software package – Graphics COPE in its previous version – developed by Colin Eden and his colleagues. The analysis of the content and structure of Taylor's thinking should produce a more in-depth and detailed knowledge and understanding of his ideas. The graphic representation is also interesting since it should make Taylor's ideas easier to communicate, for educational and other purposes. Finally, the research may also make a methodological contribution, by showing how cognitive mapping and the use of Decision Explorer can enrich our understanding of individual and collective administrative science theories (see in particular Cossette and Lapointe (1997), on macroeconomic theory, and Jeanson and Cossette (1996), on knowledge of the field of real estate). First, however, it is important to state what we mean by the term "cognitive map", and to describe the procedure followed to identify the concepts and links present in Taylor's work.

Concept of cognitive map

A cognitive map is a graphical representation of the researcher's mental representation of a set of discursive representations expressed by a subject based on his or her own cognitive representations with regard to a specific object (Cossette and Audet, 1994, p. 15).

For these authors, therefore, a cognitive map is a figure or an image, even if the distinction between the evoked content and the graphical representation is not always clearly established by the people using it (see in particular Weick and Bougon, 1986). It is composed of two elements: *concepts*, which are treated as variables or as constructs (each being composed of an idea and its opposite, according to the individual); and

links, often influential links (although some authors prefer to call them "causal" links, which seems abusive), between some of the concepts, forming influential paths, i.e. paths linking one concept to another through one or more other concepts, or even loops in which a concept has an indirect influence on itself.

Given that a concept takes its true meaning from its links to other concepts (Bougon *et al.*, 1977; Eden *et al.*, 1983), a cognitive map highlights a *semantic* network which, when proposed as the representation of a cognitive structure or "schema" (as is the case here), serves as a reference system for the holder, to guide that person in his or her actions, interpretations and forecasts (Weick, 1979; Lord and Foti, 1986). This network can be subjected to a special form of analysis that would have been difficult, if not impossible, otherwise. In this respect, the Decision Explorer package can be extremely useful, since it can be used to highlight the holistic and systemic nature of the model represented, as we will see later. The analysis is based mainly on the topography of the cognitive map in other words, on a study of the structure formed by the concepts and the links between them.

Another characteristic of the cognitive map, according to the definition used here, is that it is a construction produced by the researcher on the basis of his or her own representation of the ideas expressed by a subject or subjects. This understanding is therefore basically subjective in nature, in agreement with the precepts of radical constructivism (von Glaserfeld, 1985). It is very clear that, when producing a cognitive map or any other type of knowledge, researchers cannot remove themselves from the process. They possess personal schemas, or borrow theoretical schemas that they consider appropriate for the project in question, and these schemas inevitably guide them as they select the concepts and links for the cognitive map. Not only is the cognitive map a material product to which the researcher has contributed, but it is impossible to state with any degree of certainty that it is a perfect reflection of the discursive representations from which it was produced. Generally speaking, at the ontological level, we cannot presume that a strict *correspondence* exists between the four types of representations shaped during the series of operations leading to the construction of a cognitive map (Cossette and Audet, 1994).

Hence, the cognitive map presented in this research is composed of concepts and links that constitute the thinking of Taylor, as

expressed by him in his writing, and as “understood” by the researcher who represented that thinking graphically in the form of a cognitive map. It reveals a semantic network that will be analysed using the Decision Explorer software package.

Identification and representation of concepts and links

Most of the work of identifying the concepts and links in Taylor’s thinking was carried out using the first French version of “Shop management” (1903), published in 1907 in the *Revue de Métallurgie* and reproduced in its entirety (except for a few corrections to the form) in Vatin, under the title “Direction des ateliers”. As Vatin (1990) points out, there is broad agreement that this text by Taylor, although very badly written, is the one that contains the most complete formulation of his ideas. To quote Le Chatelier, *The Principles of Scientific Management* is simply a “summary” of “Shop management” (Vatin, 1990, p. 10). Nevertheless, the first English version of *Principles* was also analysed in detail, to identify any concepts and links that were not evoked in “Shop management”. Efforts were made to formulate the concepts (variables or constructs) using the same words as Taylor, taking into account, of course, any differences due to the translation from English to French. If we are really to respect the subject’s reference system, this is one of the general principles that must be applied rigorously (Huff *et al.*, 1990).

Identifying the influential links established by Taylor between two concepts turned out to be a complex undertaking. The use of linking terminology, verbs and expressions often signals the existence of such a link. For example:

- because;
- in order to;
- with a view to;
- leads to;
- influences;
- causes;
- explains;
- results;
- has the consequence of;
- makes possible;
- allows;
- increases; or
- reduces.

However, the task of identifying these links was, let us say, somewhat fastidious, due to the many repetitions and imprecisions, the frequent absence of any sequential consistency between the ideas presented and the poor structure of the text. Moreover, we

had to be sure that Taylor’s assertion of the existence of an influential link between two concepts actually referred to a *direct* link (which was rarely the case). Otherwise, the intermediary concepts had to be sought elsewhere in the text. In other words, when drawing up the cognitive map, we had to be sure that the longest path between two concepts was not simply a more detailed version of a shorter path between the same two concepts – a situation that caused us to retain only the longest path, to avoid repetition of ideas. Also, in accordance with usual practice in cognitive mapping, Taylor’s recognition of a *possible* (as opposed to *real*) influence by one concept on another was considered sufficient for inclusion in the cognitive map.

Hence, every concept that exercised a direct real or possible influence over another concept was linked graphically to that other concept by means of a line ending in a arrow. If the relationship between the two was negative – in other words, if an increase in the level of the explanatory concept led, in Taylor’s view, to a reduction in the level of the concept considered to be a consequence (or vice-versa), a “–” sign was added to the line. Every effort was made to reduce both the distance between related concepts and the number of intersecting lines.

Although, as mentioned earlier, the cognitive map is necessarily a product to which the researcher contributes, it is nevertheless important for it to be credible – “valid”, some people would say, to use a more orthodox term. Accordingly, Appendix 1 contains a list of the concepts identified, and Appendix 2 shows the precise location (or, more frequently, locations) of the remarks by Taylor that led the researcher to conclude that an influential link existed between the two concepts. These locations are very easy to find, since the translation presented in Vatin follows the numbered paragraph formula used in the original edition. As regards *The Principles of Scientific Management* (PSM), the figures shown in Appendix 2 refer to page numbers, not paragraph numbers. It should be remembered that this latter publication was used to obtain only the concepts and links that had not already been evoked in “Shop management” (SM). They appear in italics on the cognitive map, and are therefore easy to distinguish.

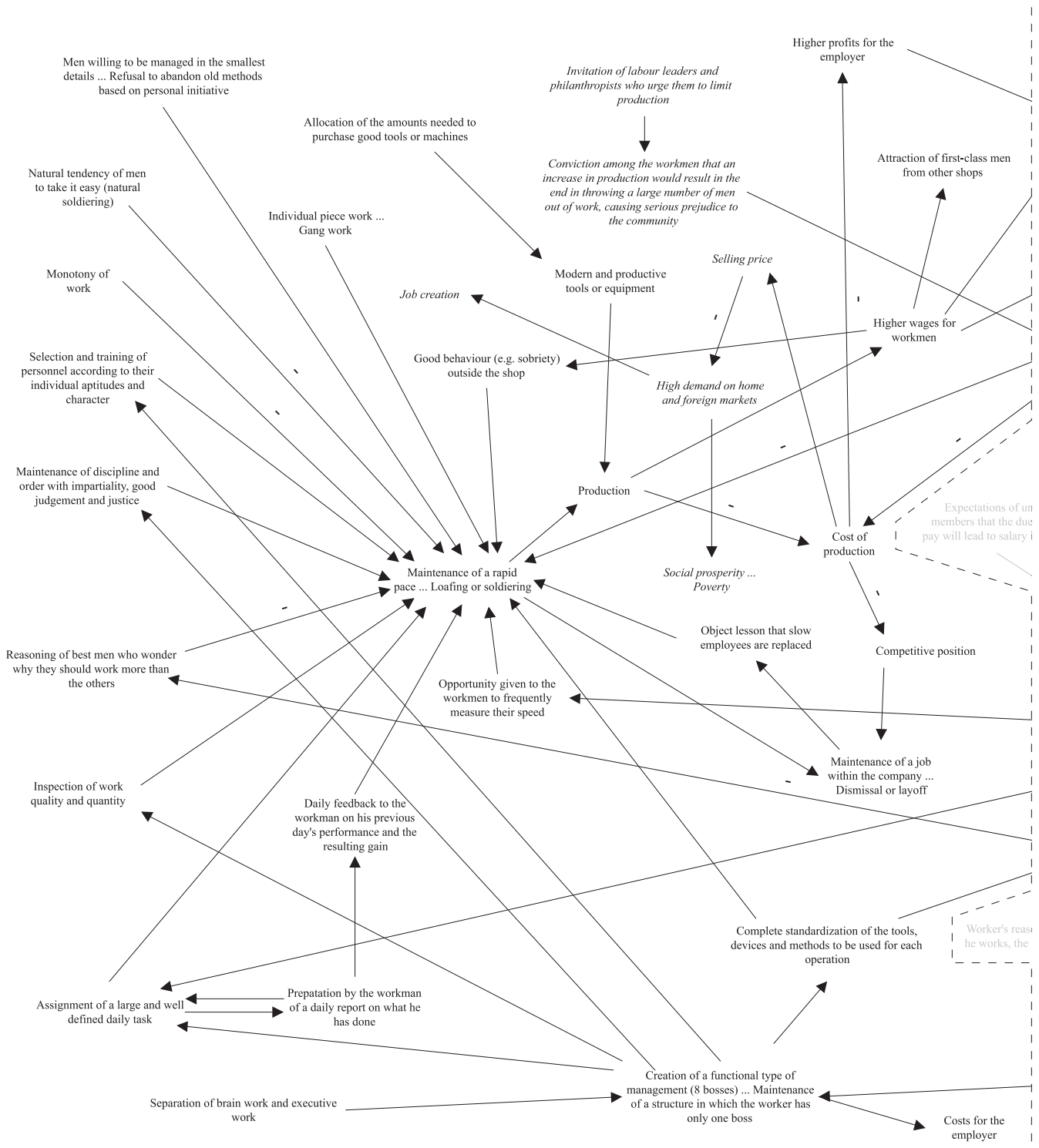
Results

The cognitive map (Figure 1) shows that Taylor’s conception of the organization of

work was based on 61 concepts and 77 links. The “density” of the figure, which can be established very precisely by dividing the number of links on the map by the maximum possible number (i.e. if every concept was

linked to every other concept)[1], is not very high, at 0.02, which might suggest that Taylor’s thinking was not particularly “complex”. We will come back to this aspect later.

Figure 1
 Cognitive map of F.W. Taylor



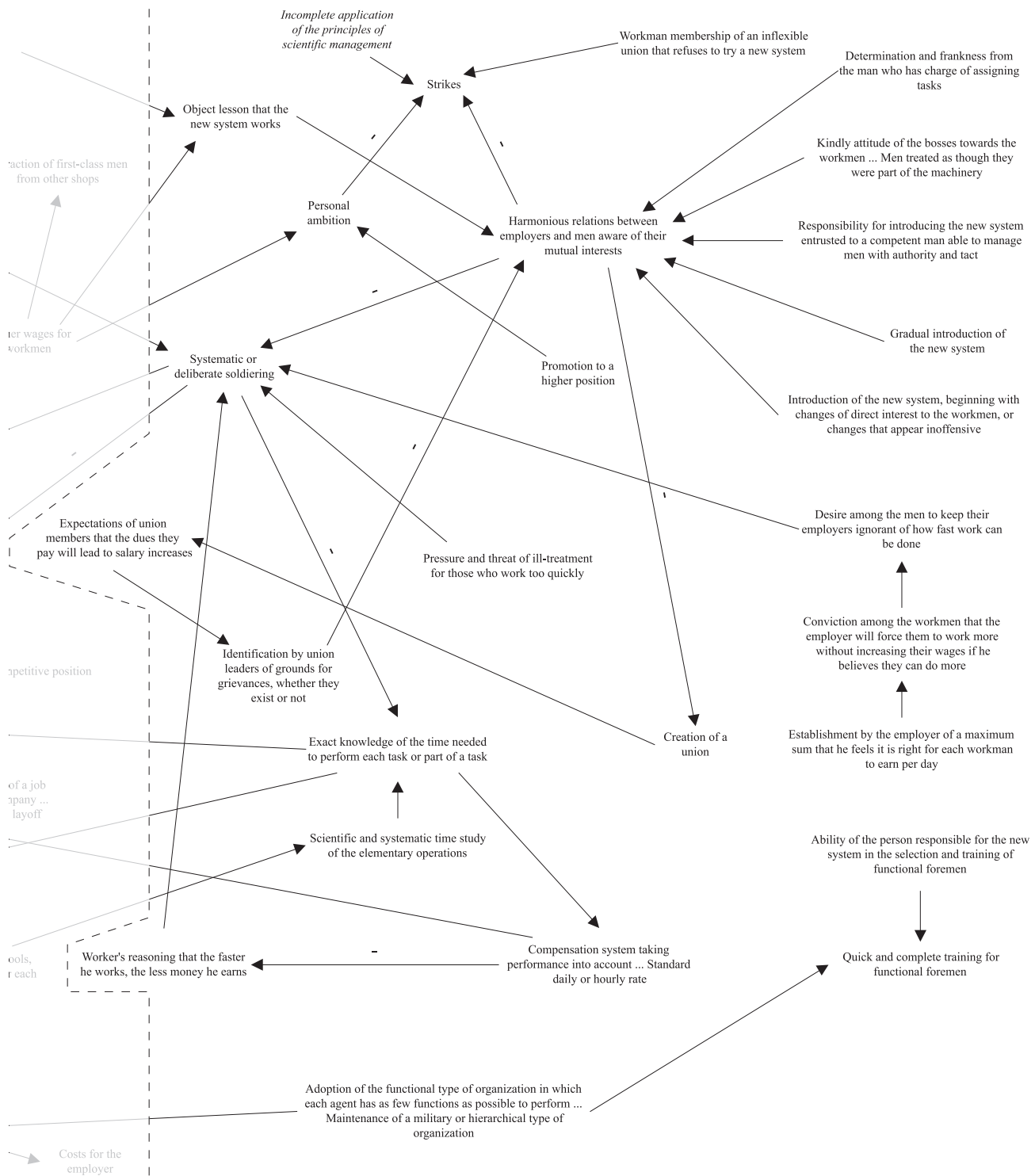
(continued)...

If we look at the seven concepts evoked by Taylor solely in *The Principles of Scientific Management* below, we can see that his interest in the organization's environment (a drop in sales prices leading to increased demand, itself leading to social prosperity and the creation of jobs[2] in the

organization) seems to have become manifest for the first time only when this text was published in 1911:

- 1 Job creation.
- 2 Invitation of labour leaders and philanthropists who urge them to limit production.

Figure 1



- 3 Conviction among the workmen that an increase in production would result in the end in throwing a large number of men out of work, causing serious prejudice to the community.
- 4 High demand on home and foreign markets.
- 5 Social prosperity . . . Poverty.
- 6 Incomplete application of the principles of scientific management.
- 7 Selling price.

It is not impossible that the many criticisms made of his system after the publication of “Shop management” were related to this “new” concern. This may not allow us to conclude that Taylor considered the organization as an *open* system, but it does suggest that he was very aware of the impact on organizational functioning of the “energy” provided by the environment. In short, the system proposed by Taylor – if “system” is the right word – was certainly not *closed* tight, at least in 1911.

The Decision Explorer analysis was intended to identify the relative importance of each concept in the system represented, to study the groups formed by concepts that were particularly closely linked, to characterize the concepts according to whether they were mainly “explanations” or “consequences”, and to identify the loops in the system represented[3]. The results of the analysis are presented and interpreted below.

Relative importance of the concepts

The literature on cognitive mapping suggests that the relative significance of each concept in a graph such as Figure 1 should be evaluated on the basis of the number of factors to which that concept is directly or both directly and indirectly related, either as an influential factor or a factor which is influenced. A variable is therefore considered to be particularly significant when it has many links with others. Thus, Weick (1979, p. 75) would say, referring to the direct links between the variables on a cognitive map:

The greater the number of inputs to and/or outputs from an element, the more important that element is.

In Bougon *et al.* (1977), it is implicit that the significance of a variable can be evaluated using an “adjacency matrix” which takes into account the number of variables directly related to it, or by using a “reachability matrix” where the indirect links are also taken into consideration. Eden *et al.* (1983) developed a more complex measurement of the significance of each concept of a cognitive map, in which both the total number of concepts acting directly or indirectly as

influencing or influential factors and the length of all the paths linking the concept to others are considered, regardless of the direction of their influence. The measure provides a “centrality score” for each concept, calculated as follows: all concepts directly related to it (first level) are worth 1; second level concepts (i.e. linked to the first ones) are worth 0.5, third level concepts are worth 0.33, fourth level concepts are worth 0.25, and so on, up to seven levels.

Table I shows the relative importance of each of the concepts having at least four direct links to other factors. Table II shows the 11 concepts that obtained centrality scores of 16 or more, based on the number of direct and indirect links and the length of the paths attaching them to the other concepts (only the first three levels were considered; Decision Explorer automatically introduces this limitation, unless otherwise instructed). The indirect links are interesting. Individuals do not necessarily have a discursive awareness of all the concepts with which a specific concept is indirectly linked (Cossette and Audet, 1992), and therefore do not always realize the importance they themselves attach – deeply, but not necessarily consciously – to that concept. This second approach for evaluating the relative significance of each concept appears to many authors to be more appropriate, because it takes into consideration the whole system in which each concept is embedded. Moreover, it appears to limit the negative effect of a subject’s possible desire – in this specific case, Taylor’s desire to leave a “good” impression.

The results as they appear here in the two tables support this. There is no obvious inconsistency between the two on the contrary, seven of the concepts appear in both the tables (none of these concepts was taken exclusively from *The Principles of Scientific Management*). They constitute the core of Taylor’s thinking, according to the analysis carried out here. If we link these concepts as directly as possible, we obtain Figure 2.

This figure clearly illustrates Taylor’s (1911) own express conception of his system. Far from being a set of techniques, it referred essentially to a state of mind requiring a “mental revolution” that would lead employees and employers to understand that it was in their common interest – that was basically economic, he presumed – to cooperate. Also, although the figure is by no means complete, it nevertheless shows the highly systemic or “circular” nature of Taylor’s thinking (every concept has an impact on itself), which the low density of the

Table I

Most important concepts, by number of direct links to other concepts

Maintenance of a rapid pace ... Loafing (or soldiering)	17
Harmonious relations between employers and men aware of their mutual interests	10
Creation of a functional type of management (eight bosses) ... Maintenance of a structure in which the worker has only one boss	8
Systematic or deliberate soldiering	8
Assignment of a large daily task	5
Exact knowledge of the time needed to perform each task or part of a task	5
Strikes	4
Cost of production	4
Higher wages for workmen	4

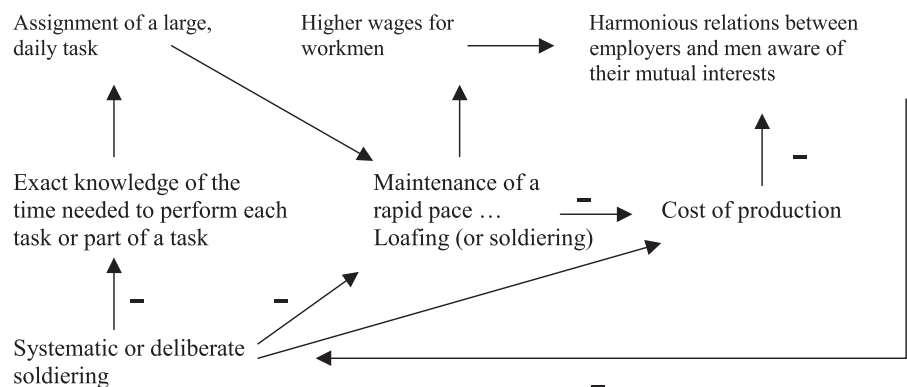
Table II

Most important concepts, by centrality score

Maintenance of a rapid pace ... Loafing (or soldiering)	30
Systematic or deliberate soldiering	27
Harmonious relations between employers and men aware of their mutual interests	24
Cost of production	19
Exact knowledge of the time needed to perform each task or part of a task	19
Production	18
Complete standardization of the tools, devices and methods to be used for each operation	17
Assignment of a large daily task	17
Higher wages for workmen	16
Desire among the men to keep their employers ignorant of how fast work can be done	16
Worker's reasoning that the faster he works, the less money he earns	16

Figure 2

Taylor's system



cognitive map did not suggest. We will come back to this point in more detail in the section on loops.

Also worthy of note is the concept clearly identified as being the most important in the two tables: "Maintenance of a rapid pace ... Wasted time". This is the most "central" concept of the system proposed by Taylor. It is easy to understand why he was given the nickname "Speedy Taylor" during his lifetime (Kanigel, 1997).

Cluster analysis

The cluster analysis shows how a person structures his or her thinking, without

necessarily being aware of it. Decision Explorer performs a cluster analysis that determines relatively isolated clusters of concepts, i.e. areas where there are a minimum number of links between the clusters. Each cluster is composed of concepts that are strongly linked between themselves, but weakly linked to other sets of concepts. In this case, the analysis takes into account only the direct links between the concepts, regardless of their direction. The minimum and maximum numbers of concepts which may be part of a cluster were set at 8 and 45 respectively, and the concept from which the analysis began was

determined at random by the algorithm – all in accordance with the standard procedure of the Decision Explorer software.

The cluster analysis revealed only two concept clusters, which is slightly surprising. In fact, here again, the low density of the cognitive map suggested that a large number of clusters would be found. As each concept has an average of only 1.26 links with other concepts (the map contains 61 concepts and 77 links in all), it is surprising that all these concepts should be so closely linked to one another that only two clusters emerge in the analysis. This observation suggests that, within the system he proposed, Taylor's ideas were highly integrated.

The first cluster contains 38 concepts and the second 23[4]. If we look more closely at the ten concepts that obtained the highest centrality scores in each cluster, we can draw certain conclusions. First, the central concepts in cluster 1 seem to be linked mainly to task performance; more precisely, they are concerned with the prior conditions likely to produce better employee performances. The cluster 2 concepts appear to be associated mainly with the results of the performance of work. Here, the consequences of adopting Taylor's philosophy regarding the mutual interests of employees and employers are clearly illustrated. In short, the prior conditions required to improve production and the results of this improvement for both employees and employers, are the two main dimensions that Taylor appears to use as a basis for his conception of the organization of work, probably without being explicitly aware of doing so:

1 *Group 1:*

- maintenance of a rapid pace ... Loafing (or soldiering);
- systematic or deliberate soldiering;
- exact knowledge of the time needed to perform each task or part of a task;
- production;
- complete standardization of the tools, devices and methods to be used for each operation;
- assignment of a large daily task;
- desire among the men to keep their employers ignorant of how fast work can be done;
- worker's reasoning that the faster he works, the less money he earns;
- conviction among the workmen that an increase in production would result in the end in throwing a large number of men out of work, causing serious prejudice to the community;
- maintenance of a job within the company ... Dismissal or layoff.

2 *Group 2:*

- harmonious relations between employers and men aware of their mutual interests;
- cost of production;
- higher wages for workmen;
- object lesson that the new system works;
- strikes;
- creation of a union;
- identification by union leaders of grounds for grievances, whether they exist or not;
- higher profits for the employers;
- determination and frankness from the man who has charge of assigning tasks;
- kindly attitude of the bosses towards the workmen ... Men treated as though they were part of the machinery.

Influenced and influential factors

The factors influenced and the influential factors were also analysed. It was not simply a coincidence that some concepts fell into one category and some into the other. Some factors tend to be considered mainly as output factors, or factors on which others have a direct influence. In other words, they seem to be mainly *consequences* or results, rather than *explanations*. In contrast, other factors tend to be considered mainly as input factors, or factors having a direct influence on a number of other factors.

Tables III and IV show, respectively, the factors influenced directly by at least three other factors, and those that directly influence at least three other factors. Interestingly, two factors – “harmonious relations between employers and men aware of their mutual interests” and “systematic or deliberate soldiering” – appear in both tables, and should therefore be considered as key variables in Taylor's thinking. He treats them as both first-order explanations and consequences in the system he proposes. These two factors are also the most likely to form part of circular influential relations, i.e. the most likely to be at the centre of a particularly complex “cognitive zone” for him. This will be considered in more detail in the section on loops.

As regards Table III, we can see that one of the five *consequences* to which Taylor paid particular attention stands out clearly from the others. This is the maintenance of a rapid pace. In Taylor's mind, 15 concepts influence it *directly*. This is a huge number, if we consider that the cognitive map contains a total of only 61 concepts and 77 links. There is no ambiguity: according to the analysis described here, Taylor's fundamental objective was the maintenance of a rapid

Table III

Factors considered strongly by Taylor to be “consequences” or outputs

Maintenance of a rapid pace ... loafing (or soldiering)	15
Harmonious relations between employers and men aware of their mutual interests	7
Systematic or deliberate soldiering	5
Strikes	4
Assignment of a large daily task	3

Table IV

Factors considered strongly by Taylor to be “explanations” or inputs

Creation of a functional type of management (eight bosses) ... Maintenance of a structure in which the worker has only one boss	6
Higher wages for workmen	4
Harmonious relations between employers and men aware of their mutual interests	3
Systematic or deliberate soldiering	3
Exact knowledge of the time needed to perform each task or part of a task	3

pace in the performance of work (or a reduction in the amount of loafing or soldiering).

Table IV also shows the particular importance of a concept that Taylor considered much more important than the others, but this time as an “explanatory” factor. This is the creation of a functional type of management comprising eight bosses. As was the case for rapid pace in Table III, this factor is linked directly to twice as many concepts as the next-ranked concept – although we are talking here of six links, rather than the 15 in the previous table. The importance of this new structure, which would be described as a “matrix” structure today, is even more clear when we consider the two factors on the cognitive map that lead to its creation – or that “explain” it. These are the separation of intellectual organizational work and executive work, which refers to the idea of the division of work; and the adoption of the functional type of organization in which every agent has as few functions as possible to perform, which refers to the idea of task compartmentalization. These two ideas, which certainly appear to be among the first associated with Taylorism by many intellectuals, are important in Taylor’s thinking essentially because they lead directly to the creation of this new eight-point administrative structure, which thus becomes a key intermediate concept in a good organization of work, even though it does not generally receive much consideration in Taylor’s thinking. This is especially true in that these two factors associated with the division of work and the compartmentalization of tasks are the only ones on the cognitive map to have a (direct or indirect) influence on the creation of an eight-point administrative management, and they are not themselves influenced by any

other factor in Taylor’s discourse. Fayol (1916), for whom the unity of command was one of the major principles of a sound organization of work, and who, during his lifetime, explicitly opposed Taylor on this subject, must be spinning in his grave.

Loops

Concepts are sometimes linked in such a way as to form *paths*, or routes linking one concept to another through the intermediary of one or more other concepts. A path becomes a *cycle* or *loop* when the final concept is related to the initial one, i.e. when a factor indirectly has an influence on itself. A loop is said to be positive when it contains an even number of negative links or none at all, and negative when it contains an odd number of negative links. A positive loop is deviation-amplifying, i.e. the initial trend between each pair of concepts never changes. The resulting spiralling movement has a destabilizing effect on the system as a whole because it is monotonous, which means that the value of each concept always changes in the same direction once the movement has been initiated. From that point, the system can spin out of control. Similarly, a negative or deviation-countering loop has a stabilizing effect on the system (Maruyama, 1963), because the system dynamics mean that the value of each concept increases and decreases – or vice-versa – *alternatively*.

A total of 22 of the 61 concepts[5] on Taylor’s cognitive map are involved in a grand total of 93 loops. These are essentially the concepts that allow us, today, to assert that the ideas proposed by Taylor formed a *system*, even if feedback or circularity was not recognized at the beginning of the century as a fundamental characteristic of a system. This circular logic, which characterizes a large part of Taylor’s

thinking, and constitutes a somewhat unexpected result given the low density of the map, bears witness to a much greater cognitive complexity in Taylor, although it is difficult to be very precise in this respect. According to Eden *et al.* (1992), the presence of a large number of concepts involved in the formation of loops only reveals a high level of cognitive complexity if the subject is clearly aware of the loops – a view that we do not share here. Taylor certainly did not have a “discursive” awareness of these loops and all the concepts that formed them; he was probably “unaware”, or he may perhaps have had a “practical” awareness of some of the loops, to use Giddens’ (1987) terms.

The concepts involved most strongly in the formation of loops are presented in Table V. Taylor appears to have had circular or systemic thinking much more with respect to the concepts at the core of his philosophy than with respect to those associated with the specific techniques he proposed (see the excellent article by Locke (1982) in this regard). His obsession with efficiency – the first two concepts in Table V provide an eloquent illustration of this – also form part of this same logic. Finally, the cognitive map obviously contains a large number of positive and negative loops, as well as several concepts that form part of *both* stabilizing loops and destabilizing loops. This simply adds to the complexity of the schema illustrated, and suggests that Taylor had a much higher level of tolerance for ambiguity than he himself, or those who have analysed his thinking, might have believed.

Discussion and conclusion

The goal of this research was to represent Taylor’s thinking graphically, in the form of a cognitive map, and to analyse it using the Decision Explorer software. The results illustrate the relative importance of each of the concepts he used, the dimensions he applied, consciously or not, when structuring his own thinking, the nature and

characteristics of the concepts he considered to be mainly explanations or mainly consequences (or both), and the more or less systemic or circular logic that guided him in organizing his ideas. The results also enable us to characterize in a very particular and precise way the structure and content of the thinking of a man who has undeniably had a remarkable influence.

More specifically, we have seen that Taylor conceived the organization of work according to 61 concepts and 77 links, and that the most interlinked concepts, i.e. the most “central” ones, were associated more with the philosophy of his proposed system than with the techniques he used. This observation was also made in the analysis of the concepts most involved in the formation of loops (Table V). It suggests that Taylor (1911, pp. 9-10) was not lying, either consciously or unconsciously, when he said that:

Scientific management . . . has for its very foundation the firm conviction that the true interests of the two are one and the same; . . . that it is possible to give the workman what he most wants – high wages – and the employer what he wants – a low labour cost for his manufactures . . . The mechanism of management must not be mistaken for its essence, or underling philosophy (Taylor, 1911, p. 68).

We have also shown that the most important concept for Taylor, according to the two calculation methods used here, was “the maintenance of a rapid pace”. Given that this factor is also by far the most important “consequence” of his cognitive map – 15 concepts directly influence it, as Table III shows – as well as the second most important concept in the formation of loops (see Table V), there is no doubt that Taylor was really obsessed with efficiency and particularly with speed.

The cluster analysis performed with Decision Explorer revealed that, fundamentally, Taylor organized his thinking around two main dimensions, i.e. the conditions required to improve production, and the results of the

Table V

Concepts involved in the formation of 61 loops or more

Systematic or deliberate soldiering	85
Maintenance of a rapid pace . . . Loafing (or Soldiering)	81
Harmonious relations between employers and men aware of their mutual interests	81
Object lesson that the new system works	72
Exact knowledge of the time needed to perform each task or part of a task	63
Production	61
Higher wages for workmen	61

Note: The other 15 concepts are each involved in the formation of 44 loops or less

improvement, although he was not clearly aware of this. The small number of dimensions to emerge from the cluster analysis, combined with the fact that more than a third of the 61 concepts are involved in loops, suggests that Taylor's thinking was not only highly "differentiated", but also well "integrated", even though the low density of the cognitive map (0.02) may have suggested that Taylor's thinking was not particularly complex.

Taylor sometimes used the word "system" to describe his concept of scientific management, even going so far as to say that:

In the past the man has been first; in the future the system must be first (Taylor, 1911, p. 8).

However, he never defined this concept explicitly, simply comparing it to a "scheme" (Taylor, 1903, para. 18). Before von Bertalanffy (1950) and others that followed him, the features of a system had not been studied to any extent. Moreover, Taylor hardly ever clearly evoked the idea of circularity or equifinality in his proposed semantic network, and in addition his own behaviour as a researcher and consultant suggested that his system could be reduced to the sum of its parts, and that the cause-and-effect links in that system were strictly linear. As a researcher, Taylor always used an experimental approach within which he manipulated independent variables in order to discover their effect on dependent variables. In doing this, he isolated those variables from everything of which they formed a part, and did not consider the possibility of feedback. As a consultant, Taylor generally restricted his interventions to the elements in his system (Kanigel, 1997). Hence, in his own concrete actions, the whole really did not appear to be irreducible, a situation that is reminiscent of the distinction established by Argyris and Schön (1974) between "espoused theory" and "theory-in-use".

However, the cognitive map produced here, and its subsequent analysis, tend to suggest otherwise. First, as we pointed out at the beginning of the analysis, Taylor explicitly acknowledged the contribution of the environment to the organization's operation, which is the fundamental feature of any so-called open system. Also, circularity, including feedback, is omnipresent in his cognitive map – there are 93 loops created by 22 of the 61 concepts. Lastly, it is clear from a glance at the cognitive map that different initial conditions and different paths can lead to the same result, which is the operational definition of equifinality. Yet, this important idea associated with the concept of system is

clearly inconsistent with the "one best way" openly sought by Taylor. Generally speaking, we can suppose that Taylor did not have a very explicit awareness of the systemic nature of his thinking.

The results of this study offer several avenues for future research. For example, the study of the paths linking one concept to another sometimes reveals what Bougon *et al.* (1977) called "logical inconsistencies" that occur when one concept has *both* a positive *and* a negative impact on another concept. According to these same authors, however, from a strictly rational standpoint the effect of one concept on another should not depend on the path. What does this mean in Taylor's cognitive map? Are there many of these supposed logical inconsistencies in the cognitive structure as it is represented here? What concepts are involved? These same questions could also be raised for the concepts involved in the formation of positive *and* negative loops.

It would also be interesting to make a detailed and holistic study of Taylor's conception of some of the elements in his cognitive map. For example, the creation of a functional administrative management with several bosses, which he associated directly with the division of labour and task compartmentalization among administrative agents, is a concept that is not used by most modern organizations, even though many of its related factors have been adopted. An in-depth analysis of this concept, taking into account the general network into which it fits, could be extremely enriching.

As we have seen, the graphical representation in the form of a cognitive map is useful in many ways, but it is also difficult to produce and raises a number of questions that may lead to other avenues for research. For example, it is legitimate to evaluate the relative importance of each concept according to the number of links, direct or not, to other concepts. However, the exclusive use of a quantitative criterion for this purpose is not entirely satisfactory. For example, a concept could be considered more "important" because, according to the subject, it influences a factor considered crucial, or because its influence is perceived as stronger or more determining than that of another factor (Cossette and Audet, 1992; Cossette, 1994). In the present case, it would be interesting to see how far the factors considered most important in the analysis carried out here (see list of seven concepts evoked by Taylor and Table I) were also considered to be the most important by Taylor himself in his explicit affirmations. Such a study could even include the

interpretations of Taylor's thinking by certain analysts.

In addition, although it is generally agreed in cognitive mapping research to date that a link between two concepts reflects a *real* or *possible* influence, there is a very clear distinction between these two types of influence that should perhaps be taken into consideration in the future. The former type produces a kind of complete or partial theory held by the subject, while the latter gives rise to a probabilistic theory. Consideration of all this additional information on the influential link would certainly help when refining a cognitive map such as that produced for Taylor, but it would also make it more cumbersome and probably much more difficult to analyse.

The research described here has shown that cognitive mapping as a tool can be useful in helping analyse the ideas proposed by an author or group of authors, whether in organization theory or in other areas. Obviously, such ideas are better suited to the cognitive mapping process when the concepts they convey are clearly expressed as "explanations" or "consequences" of other concepts, which was the case for most of Taylor's ideas. In this respect, it should be remembered that a cognitive map does not do full justice to a person's ideas if it represents only the influential link. However, theorists (whether practitioners or not) usually tend spontaneously to think in terms of explanations and consequences. In the study of organizations, as observed by Weick and Bougon (1986), this tendency appears to go without saying, perhaps because the concept of organization suggests the transformation of inputs into outputs. Generally speaking, the results obtained in this research will encourage the use of cognitive mapping among researchers who wish to know and understand both the content and the structure of the thinking of knowledge producers. A more profound understanding of the conceptual models of past and present authors, in the administrative sciences as well as in other fields, is an important contribution, especially at the historical level.

Finally, from the educational standpoint, the graphical representation of the thinking of Taylor or other authors will certainly help facilitate teaching and discussion. In some cases, it may even produce hitherto unsuspected theoretical developments. "A picture is worth a thousand words", goes the saying. Sometimes it is worth much more.

Notes

- 1 The formula used to calculate density is as follows: $L/C(C-1)$ where L is the number of links on the map and C the number of concepts. In the present case, the density is: $77/61(60) = 0.02$.
- 2 In "Shop management", Taylor speaks of job "maintenance" rather than job "creation" as a direct consequence of the maintenance of a rapid pace or a good competitive position in the company. In *The Principles of Scientific Management*, this aspect is addressed more clearly.
- 3 My thanks go to Dominique Thuot for his work on the graphic design of the cognitive map, and on the Decision Explorer analyses.
- 4 The numbers of the concepts in the first cluster are: 1-17, 19-23, 25, 27, 32, 34-42, 53, 55, 56 and 58. All the other concepts belong to the second cluster.
- 5 In Appendix 1, the numbers of these concepts are: 6, 8, 10-14, 25, 27, 28, 30, 32-35, 51, 54, 55, 57, 58, 60 and 61.

References

- Argyris, C. and Schön, D.A. (1974), *Theory in Practice: Increasing Professional Effectiveness*, Jossey-Bass, San Francisco, CA.
- Bougon, M.G., Weick, K.E. and Binkhorst, D. (1977), "Cognition in organizations: an analysis of the Utrecht Jazz Orchestra", *Administrative Science Quarterly*, Vol. 22, pp. 606-39.
- Copley, F.B. (1923), *Frederick W. Taylor: Father of Scientific Management* (two volumes), Harper & Brothers, New York, NY.
- Cossette, P. (1994), "La carte idiosyncratique. Étude exploratoire des schèmes personnels de propriétaires-dirigeants de PME", in Cossette, P. (Ed.), *Cartes Cognitives et Organisations*, Collection "Sciences de l'administration", Les Presses de l'Université Laval and Paris, Éditions ESKA, Québec, pp. 113-54.
- Cossette, P. and Audet, M. (1992), "Mapping of an idiosyncratic schema", *Journal of Management Studies*, Vol. 29 No. 3, pp. 325-47.
- Cossette, P. and Audet, M. (1994), "Qu'est-ce qu'une carte cognitive?", in Cossette, P. (Ed.), *Cartes Cognitives et Organisations*, Collection "Sciences de l'administration", Les Presses de l'Université Laval and Paris, Éditions ESKA, Québec, p. 13-33.
- Cossette, P. and Lapointe, A. (1997), "A mapping approach to conceptual models: the case of macroeconomic theory", *Canadian Journal of Administrative Sciences*, Vol. 14 No. 1, pp. 41-51.
- Drucker, P.F. (1976), "The coming rediscovery of scientific management", *Conference Board Record*, pp. 23-7.
- Eden, C., Ackermann, F. and Cropper, S. (1992), "The analysis of cause maps", *Journal of Management Studies*, Vol. 29 No. 3, pp. 309-24.

- Eden, C., Jones, S. and Sims, D. (1983), *Messing About in Problems*, Pergamon, Oxford.
- Fayol, H. (1916), *Administration Industrielle et Générale*, Dunod, Paris.
- Giddens, A. (1987), *La Constitution de la Société. Éléments de la Théorie de la Structuration*, Presses universitaires de France, Paris.
- Huff, A.S., Narapareddy, V. and Fletcher, K.E. (1990), "Coding the causal association of concepts", in Huff, A.S. (Ed.), *Mapping Strategic Thought*, John Wiley & Sons, Chichester, UK, p. 311-25.
- Jeanson, B. and Cossette, P. (1996), "Le champ des affaires immobilières: une étude de cartographie cognitive", *Revue Internationale de Systémique*, Vol. 10 No. 1-2, pp. 131-51.
- Kakar, S. (1970), *Frederick Taylor: A Study in Personality and Innovation*, MIT Press, Cambridge, MA.
- Kanigel, R. (1997), *The One Best Way: Frederick Winslow Taylor and the Enigma of Efficiency*, Penguin Books, New York, NY.
- Locke, E.A. (1982), "The ideas of Frederick W. Taylor: an evaluation", *Academy of Management Review*, Vol. 7 No. 1, pp. 14-24.
- Lord, R.G. and Foti, R.J. (1986), "Schema theories, information processing, and organizational behavior", in Sims, H.P. Jr and Gioia, D.A. (Eds), *The Thinking Organization: Dynamics of Organizational Social Cognition*, Jossey-Bass, San Francisco, CA, pp. 20-48.
- Maruyama, M. (1963), "The second cybernetics: deviation-amplifying mutual cause processes", *American Scientist*, Vol. 51, pp. 164-79.
- Nelson, D. (1980), *Frederick W. Taylor and the Rise of Scientific Management*, University of Wisconsin Press, Madison, WI.
- Taylor, F.W. (1903), "Shop management", *Transactions. American Society of Mechanical Engineers*, Vol. XXIV, pp. 1337-456.
- Taylor, F.W. (1911), *The Principles of Scientific Management* (special edition distributed to the members of the American Society of Mechanical Engineers), Harper & Brothers, New York, NY.
- Taylor, F.W. (1990), "Direction des ateliers", in Vatin, F. (Ed.), *Organisation du Travail et Économie des Entreprises* (published for the first time in French in 1907), Les Éditions d'organisation, Paris, pp. 27-138.
- Vatin, F. (1990), "Introduction. Le taylorisme et les sciences de gestion, hier et aujourd'hui", in Vatin, F. (Ed.), *Organisation du Travail et Économie des Entreprises*, Les Éditions d'organisation, Paris, pp. 9-25.
- von Bertalanffy, L. (1950), "An outline of general systems theory", *British Journal of Philosophical Science*, Vol. 1, pp. 134-65.
- von Glasersfeld, E. (1985), "Reconstructing the concept of knowledge", *Archives de Psychologie*, Vol. 53, pp. 91-101.
- Weick, K.E. (1979), *The Social Psychology of Organizing*, 2nd ed., Addison-Wesley, Reading, MA.
- Weick, K.E. and Bougon, M.G. (1986), "Organizations as cognitive maps: charting ways to success and failure", in Sims, H.P. Jr and Gioia, D.A. (Eds), *The Thinking Organization: Dynamics of Organizational Social Cognition*, Jossey-Bass, San Francisco, CA, p. 102-35.
- Wrege, C.D. and Greenwood, R.G. (1991), *Frederick W. Taylor, the Father of Scientific Management: Myth and Reality*, Irwin, New York, NY.
- Wrege, C.D. and Stotka, A. (1978), "Cooke creates a classic: the story behind F.W. Taylor's principles of scientific management" *Academy of Management Review*, Vol. 3 No. 4, pp. 736-49.
- Wren, D.A. and Hay, R.D. (1977), "Management historians and business historians: differing perceptions of pioneer contributors", *Academy of Management Journal*, Vol. 20 No. 3, pp. 470-5.

Appendix 1. List of concepts

1. Men willing to be managed in the smallest details . . . Refusal to abandon old methods based on personal initiative
2. Natural tendency of men to take it easy (natural soldiering)
3. Monotony of work
4. Selection and training of personnel according to their individual aptitudes and character
5. Maintenance of discipline and order with impartiality, good judgement and justice
6. Reasoning of best men who wonder why they should work more than the others
7. Inspection of work quality and quantity
8. Assignment of a large daily task
9. Separation of brain work and executive work
10. Preparation by the workman of a daily report on what he has done
11. Daily feedback to the workman on his previous day's performance and the resulting gain
12. Maintenance of a rapid pace . . . Loafing (or soldiering)
13. Frequent opportunities given to workmen to measure their speed
14. Maintenance of a job within the company . . . Dismissal or layoff
15. Complete standardization of the tools, devices and methods to be used for each operation
16. Creation of a functional type of management (eight bosses) . . . Maintenance of a structure in which the worker has only one boss
17. Good behaviour (e.g. sobriety) outside the shop
18. Job creation
19. Individual piece work . . . Gang work

20. Allocation of the amounts needed to purchase good tools or machines
21. Invitation of labour leaders and philanthropists who urge them to limit production
22. Conviction among the workmen that an increase in production would result in the end in throwing a large number of men out of work, causing serious prejudice to the community
23. Modern and productive tools or equipment
24. High demand on home and foreign markets
25. Production
26. Social prosperity ... Poverty
27. Object lesson that slow employees are replaced
28. Higher profits for the employers
29. Attraction of first-class men from other shops
30. Object lesson that the new system works
31. Personal ambition
32. Systematic or deliberate soldiering
33. Identification by union leaders of grounds for grievances, whether they exist or not
34. Worker's reasoning that the faster he works, the less money he earns
35. Compensation system taking performance into account ... Standard daily or hourly rate
36. Costs for the employer
37. Adoption of the functional type of organization in which each agent has as few functions as possible to perform ... Maintenance of a military or hierarchical type of organization
38. Quick and complete training for functional foremen
39. Ability of the person responsible for introducing the new system in the selection and training of functional foremen
40. Establishment by the employer of a maximum sum that he feels it is right for each workman to earn per day
41. Conviction among the workmen that the employer will force them to work more without increasing their wages if he believes they can do more
42. Desire among the men to keep their employers ignorant of how fast work can be done
43. Introduction of the new system, beginning with changes of direct interest to the workmen, or changes that appear inoffensive
44. Gradual introduction of the new system
45. Responsibility for introducing the new system entrusted to a competent man able to manage men with authority and tact
46. Kindly attitude of the bosses towards the workmen ... Men treated as though they were part of the machinery
47. Determination and frankness from the man who has charge of assigning tasks
48. Workman membership of an inflexible union that refuses to try a new system
49. Incomplete application of the principles of scientific management
50. Strikes
51. Harmonious relations between employers and men aware of their mutual interests
52. Promotion to a higher position
53. Pressure and threat of ill-treatment for those who work too quickly
54. Creation of a union
55. Exact knowledge of the time needed to perform each task or part of a task
56. Scientific and systematic time study of the elementary operations
57. Expectations of union members that the dues they pay will lead to salary increases
58. Competitive position
59. Selling price
60. Cost of production
61. Higher wages for workmen

Appendix 2. List of links

- 1 > +12 : DA, para. 295
- 2 > -12 : DA, para. 46, 47
- 3 > -12 : DA, para. 37, 175
- 4 > +12 : DA, para. 38a, 236-7, 274, 295, 321
- 5 > +12 : DA, para. 244, 275, 439-47
- 6 > -12 : DA, para. 50
- 7 > +12 : DA, para. 238, 313
- 8 > +10 : DA, para. 154, 160
- 8 > +12 : DA, para. 47, 149, 153
- 9 > +16 : DA, para. 232, 233a, 235
- 10 > +8 : DA, para. 154
- 10 > +11 : DA, para. 154, 160
- 11 > +12 : DA, para. 116-7, 160, 201-2
- 12 > +14 : DA, para. 126, 166, 199, 293
- 12 > +25 : DA, para. 292
- 13 > +12 : DA, para. 189
- 14 > +27 : DA, para. 166
- 15 > +56 : DA, para. 97, 269, 284
- 15 > +12 : DA, para. 236-7, 239
- 16 > +36 : DA, para. 142, 145, 155, 292, 326
- 16 > +15 : DA, para. 154, 237, 239, 247, 269
- 16 > +4 : DA, para. 274, 321
- 16 > +5 : DA, para. 244, 275
- 16 > +7 : DA, para. 238, 313
- 16 > +8 : DA, para. 241-3
- 17 > +12 : DA, para. 128
- 19 > +12 : DA, para. 118-22, 163
- 20 > +23 : DA, para. 145
- 21 > +22 : PSM, p. 13-4
- 22 > +32 : PSM, p. 13-4
- 23 > +25 : DA, para. 145
- 24 > +26 : PSM, para. 12, 73
- 24 > +18 : PSM, para. 13

Pierre Cossette
*Analysing the thinking of
F.W. Taylor using
cognitive mapping*

Management Decision
40/2 [2002] 168-182

**This article is based on
research presented at
the 1999 Academy of
Management meeting and
developed for publication by
Dr Kerry David Carson of the
University of Louisiana.
The author is grateful to
Christine Gardner for
translating the French
original**

25 > +61 : DA, para. 292
27 > +12 : DA, para. 166
28 > +30 : DA, para. 18-9, 295
30 > +51 : DA, para. 34, 158, 292, 294
31 > -50 : DA, para. 411
32 > -55 : DA, para. 57
32 > -60 : DA, para. 293
32 > -12 : DA, para. 46
33 > -51 : DA, para. 427-9
34 > +32 : DA, para. 55-6, 383
35 > -34 : DA, para. 55-6, 383
35 > -6 : DA, para. 49, 50, 175
37 > +16 : DA, para. 232-3b, 234-5
37 > +38 : DA, para. 246
39 > +38 : DA, para. 304
40 > +41 : DA, para. 59, 60
41 > +42 : DA, para. 62
42 > +32 : DA, para. 57, 62
43 > +51 : DA, para. 142, 297, 304
44 > +51 : DA, para. 142, 295
45 > +51 : DA, para. 296
46 > +51 : DA, para. 414-7, 440

47 > +51 : DA, para. 387
48 > +50 : DA, para. 158
49 > +50 : PSM, p. 69
51 > -50 : DA, para. 142, 158, 409-10, 416
51 > -32 : DA, para. 60, 64, 75, 292
51 > -54 : DA, para. 129, 416, 424
52 > +31 : DA, para. 411
53 > +32 : DA, para. 55, 62, 156
54 > +57 : DA, para. 429
55 > +35 : DA, para. 111, 162
55 > +13 : DA, para. 189
55 > +8 : DA, para. 29-38, 324
56 > +55 : DA, para. 93, 111, 140, 362
57 > +33 : DA, para. 429
58 > +14 : DA, para. 25, 432
59 > -24 : PSM, p. 12-3, 73
60 > +59 : PSM, p. 12-3, 73
60 > -28 : DA, para. 292
60 > -58 : DA, para. 25, 432
61 > +31 : DA, para. 199, 411
61 > +30 : DA, para. 18-9, 111, 158, 294-5
61 > +29 : DA, para. 126