Project Services Pty Ltd

Henry L Gantt, 1861 - 1919
A retrospective view of his work

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(Augmented with additional materials received since publication)

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Henry Laurence Gantt, A.B., M.E. was an American mechanical engineer and management consultant who is best known for developing the Gantt chart in the 1910s. However, the charts Henry Gantt developed and used are nothing like the charts that are erroneously referred to as 'Gantt Charts' by modern project managers.

It is a tragedy that Gantt's real contributions to the advancement of management science are obscured by two glaring misconceptions that continue to be perpetuated by sloppy scholarship with various authors repeating earlier incorrect assertions without ever bothering to check the original source materials[1]. This article is intended to set the record straight and recognise Gantt for his real achievements!

Henry Gantt was a very important management scientist; his contribution to production engineering is rightly recognised by the American Society of Mechanical Engineers (ASME) by awarding an annual medal in his honour. The Henry Laurence Gantt Medal, was established in 1929 and elevated to a Society award in 1999, it is given for distinguished achievement in management and for service to the community.

Hopefully by the time you have finished this paper, you will agree the following myths should be 'busted' once and for all:

Misconception #1 Henry Gantt developed 'Bar Charts' – Fact, bar charts were developed 100 years before Gantt, his charts were sophisticated production control tools, not simple representations of activities over time.

Misconception #2 Henry Gantt contributed to the development of 'project management' – this is a complete fallacy, Gantt's work was in machine shops and factories focused on batch production and factory throughput. Many of his ideas can be adapted to modern project management but Gantt sought to eliminate 'one-off' jobs that could not be batched and managed efficiently.

Source Materials:

Thanks to the digitisation of historically significant books, the three original books relating to Gantt's work are now in the public domain:

- Work Wages & Profits (Henry L. Gantt, 1916)
- Organizing for Work (Henry L. Gantt, 1919)
- The Gantt Chart a working tool of management (Wallace Clark, 1923)

For convenience of readers, all three books can be downloaded from:
https://mosaicprojects.com.au/PMKI-ZSY-025.php#Process1

Bar Charts and Gantt Charts:

Throughout his career, Henry Gantt used a wide range of charts; in fact it would be true to say that one of Gantt's core skills was developing charts to display relatively complex data in ways that allowed quick and effective comprehension by managers. However none of these

[1] To see the events discussed in this paper in a comprehensive historical timeline download ***Project Management - A Historical Timeline***:
https://mosaicprojects.com.au/PDF_Papers/P212_Historical_Timeline.pdf

charts were simple forward projections of activities against time (ie, the conventional 'bar chart' used on modern project management), and the term 'Gantt Chart' was first used in the Wallace Clark book, where he describes the use of Gantt's charts to measure productivity.

The origin of the Bar Chart.

The concept of 'scheduling' is not new; the pyramids are over 3000 years old; Sun Tzu wrote about scheduling and strategy 2500 years ago from a military perspective; transcontinental railways have been being built for some 200 years, etc[2]. None of these activities could have been accomplished without some form of schedule; ie, the understanding of activities and sequencing. However, whilst the managers, priests and military leaders controlling the organisations responsible for accomplishing these 'works' must have an appreciation of 'scheduling' (or at least the successful ones would have) there is little evidence of formal processes until the 18th Century[3].

Modern bar charts can trace their origins to 1765. The originator of the concept appears to be Joseph Priestley (England, 1733-1804); his *'Chart of Biography'* plotted some 2000 famous lifetimes on a time scaled chart. Priestley is quoted as saying *"…a longer or a shorter space of time may be most commodiously and advantageously represented by a longer or a shorter line."*

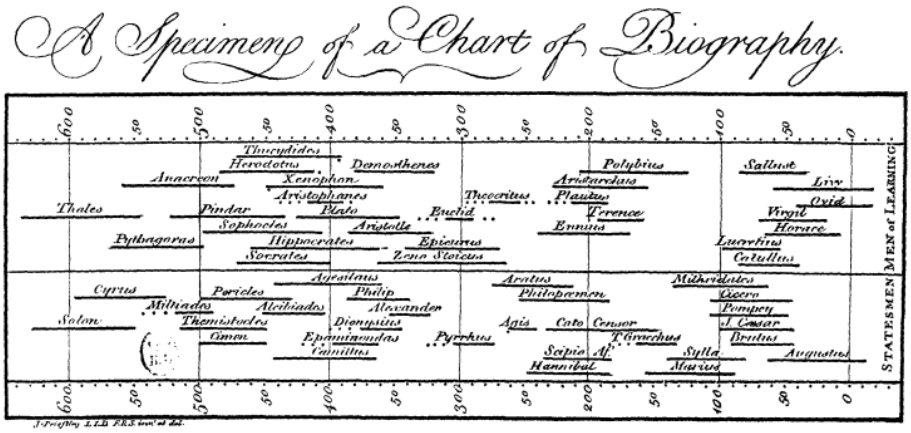


Figure 1 – Joseph Priestley: Chart of Biography

[2] For more examples see: https://mosaicprojects.com.au/PDF_Papers/P158_Henry_Gantt_PPT.pdf

[3] These examples may not be the earliest use of the concepts of bar charts. Daniel Defoe published: ***An essay upon projects*** in 1697 which discusses projects from the year 1680 onwards (but recognises there were earlier projects). The Bridgewater Canal was opened in 1761 (followed by 100s of miles of others in a period of around 60 years) until the railways took over from 1825 onwards. These projects and later ones such as the Crystal Palace (1850) had to have been effectively managed as well as designed and fabricated – there were time and cost constraints on the builders/engineers and 1000s of workers deployed.

Similarly, the origins of using diagrams in preference to words to describe ideas was the subject of much scientific debate at the end of the 17th Century (Robert Hook published *Micrographia*, in 1665 that used diagrams to describe specimens viewed through an early microscope, he was greatly concerned about the possibility of misinterpretation). Advances in printing allowed Joseph Priestley (England, 1733-1804) to publish his 'Chart of Biography' in 1765, and as described in the main text, out of this heritage, William Playfair developed 'bar charts' in *his 'Commercial and Political Atlas'* of 1786.

The principles underlying the development of graphs and bar charts is traced in ***The Origins of Bar Charting***, which covers the centuries prior to 1760. However, whilst the concepts needed to create Priestley's charts can be traced back to Ancient Greece, there is no evidence of 'bar charts' prior to 1765: http://www.mosaicprojects.com.au/PDF_Papers/P182_The_origins_of_bar_charting.pdf

Priestley's ideas[4] were picked up by William Playfair (1759-1823) in his *'Commercial and Political Atlas'* of 1786[5]. Playfair is credited with developing a range of statistical charts including the line graph, bar graph (histogram), and pie charts. His *Atlas* contains 43 time-series plots and one histogram.

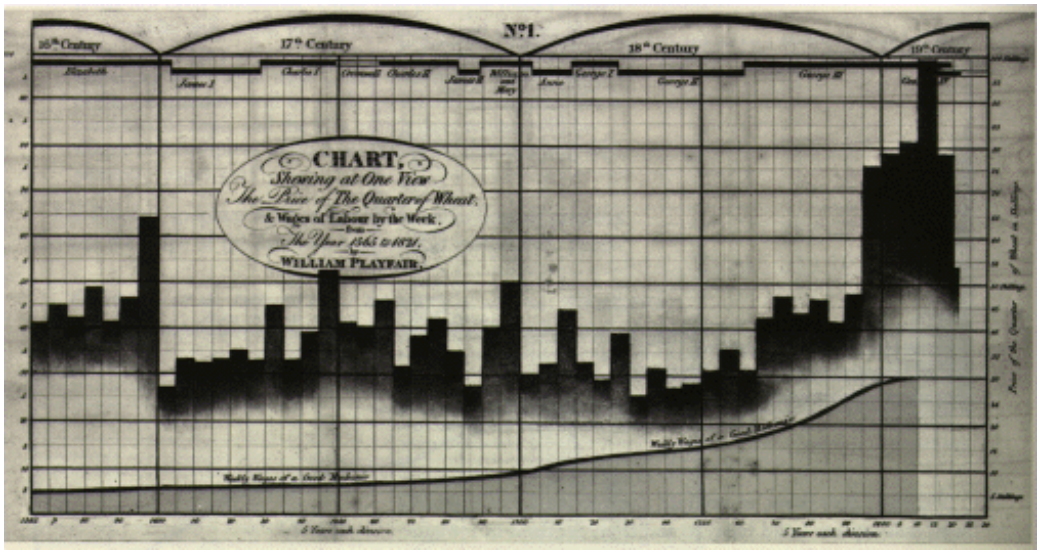


Figure 2 – One of Playfair's Charts from the 1801 edition of his Atlas

Following on from Playfair; another European, Karol Adamiecki - a Polish economist, engineer and management researcher, developed the Harmonogram (or Harmonygraph) in 1896[6]. Adamiecki's Harmonygraph has a date scale on the vertical axis (left hand side) and lists Activities across the top.

time	From	–	–	–	A–1	B–1	...
	To	A–2	B–2,C	D–2	A–3	E–1	..
	activity	A–1⟨4⟩	B–1⟨4⟩	D–1⟨2⟩	A–2⟨4⟩	B–2⟨3⟩	...
1		■	■	■			
2		■	■				
3		■	■				
4		■	■				
5					■	■	
6					■	■	
7					■	■	
8					■		
9							
10							
11							
12							
13							
14							

Figure 3 – Adamiecki's Harmonygraph

[4] For more information on the charts developed by Joseph Priestley see: https://mosaicprojects.com.au/PMKI-ZSY-020.php#Barchart

[5] Playfair, W. (1801). The Commercial and Political Atlas and Statistical Breviary. Reprinted 2005, Cambridge University Press, New York, NY.

[6] Morris P.W.G. (1994) 'The Management of Projects' Thomas Telford Ltd, London. p7.

Each activity was represented by a scaled paper strip, and the current schedule and duration of the activities were depicted by the position and length of the strips. In the header above the strips, the name and the duration of the activity and the list of preceding activities were shown. The strips representing the preceding activities were always to the left of the strip of the successor. The tabulation each activities predecessors and successors in the Harmonygraph ('from' and 'to') makes it a distinct predecessor to the CPM and PERT systems developed some 60 years later.

By 1912, the modern bar chart seems to have been fully developed and in use at least in Germany. A project to construct a small mountain railway in Bavaria was the subject of a lengthy report in the October 1915 edition of Armierter Beton[7]. The railway was of interest for the innovative use of reinforced concrete in a major bridge, not the schedule, but in passing the use of a bar chart and histogram were briefly discussed[8]:

> *A very accurate graphical building program was set up for the execution of the work, of which Fig.33 is a part. For that, each week is assumed to be five full days of real work, and thus all interruptions, by unfavourable weather, etc., were incorporated. By compiling the need for each of the individual services in the construction program to a second table (Fig. 32) the total demand at Baustoften was seen and overall performance was, with a view of the uncertain and irregular supply, achieved by timely provision being made for each appropriate supplies. The construction program was generally respected, and well laid non-structural (performance) measures about that as well as the construction program, mainly by Dipl.-Ing. J. Mulller has been designed, excellently preserved, and, despite fairly significant investment costs, has proved very economical.*

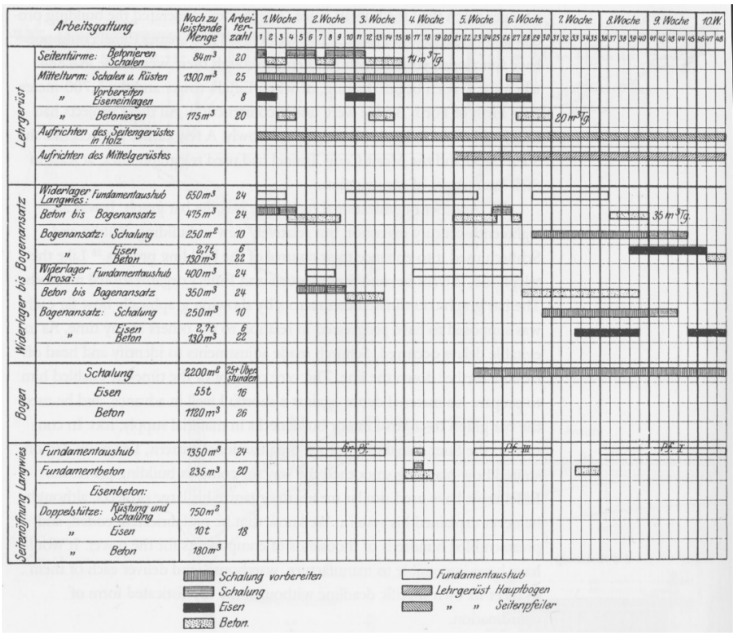


Figure 4 (Fig. 33 from the report): a Bar Chart developed for a bridge constructed in 1912.

[7] For more on the origins of the Schürch bar chart and a set of supporting resource histograms see:
The original published article (German Language):
https://mosaicprojects.com.au/PDF_Papers/P042_Barchart_Origins.pdf
A translation of the reference to the program contained in the article:
https://mosaicprojects.com.au/PDF_Papers/P042_Barchart_Origins_Comment.pdf

[8] Note, the translation is mine, using Google Translate, there may be errors.

Based on the use of language in the Armierter Beton article it would appear the use of this type of bar chart was routine[9], the only differentiation on this project was the effort put into the programming of the work.

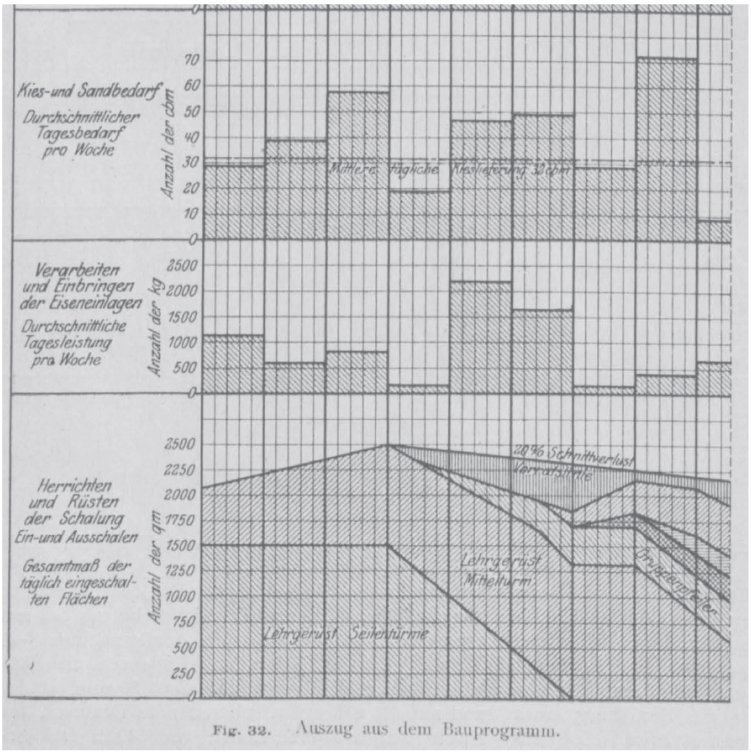


Figure 5 (Fig. 33 from the report): Part of the resource histograms from the same project.

Given the extent of use in Europe, I would suggest it is nearly impossible for an educated engineer such a Gantt to be unaware of this type of chart and its long history. He was aware of important German thinkers including Bismarck and Von Moltke and when discussing the benefits of using of his own charts, Gantt commented: *Many shops have very nice scheduling systems; they plan their work beautifully - at least, it looks very pretty on paper; but they have no means of finding out if those schedules are lived up to or not*[10]. We will never know exactly what type of chart Gantt was referencing in his disparaging remarks, but understanding what his charts could achieve would suggest he was talking about simple bar charts similar to the one above!

Gantt's Charts.

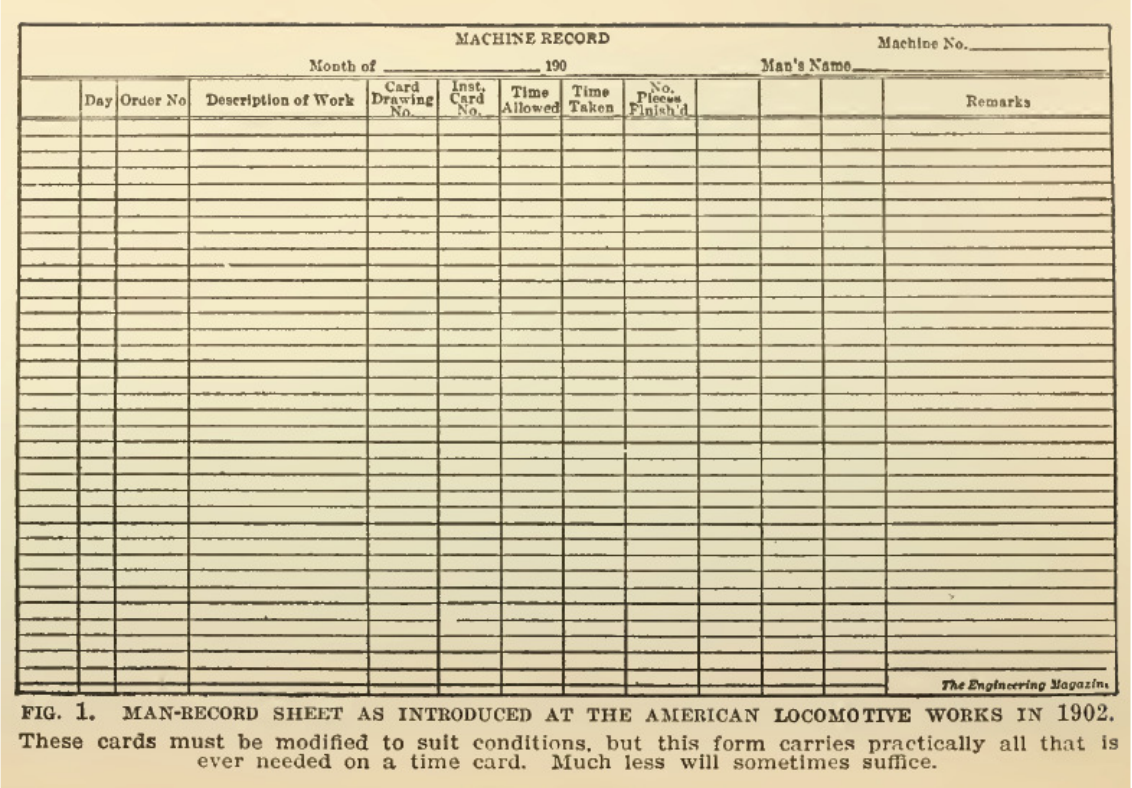
Henry Gantt developed and used a range of charts over the years to help visualise and understand data[11]. Whilst some superficially look similar to Figure 4 above, the way they

[9] The same project is discussed in a book by Schürch published in 1916: This copy of the chart is from p35 of the book.

[10] From: *Work, Wages and Profit,* p130 The task idea

[11] We do not know when Gantt developed his first charts (or the source of his inspiration). Gantt first described a version of his charts in an article published alongside Frederick W. Taylor's Shop Management paper published in *ASME Transactions 24, 1903*; in which he states they date from 1890 onwards. The two papers were to be considered jointly as an integrated production planning and control system. Gantt charts were developed contemporaneously with Taylor's system, and. Although Gantt described his daily balance as "graphical" it should be considered a "tabular" approach since no graph was used. In their initial incarnation Gantt charts were a production

were developed and the information being communicated is quite different. The primary purpose of a traditional bar chart is to show which activities are planned to be accomplished and their timing in the future (sequencing can only be inferred), whereas Gantt's charts tended to be retrospective and diagnostic. One of his earliest publications was: "A Graphical Daily Balance in Manufacture", published in 1903. These papers were consolidated into his first book, 'Work Wages and Profits', published in 1916.



MACHINE RECORD

Month of _____ 190 Machine No._____

Man's Name_____

Day	Order No	Description of Work	Card Drawing No.	Inst. Card No.	Time Allowed	Time Taken	No. Pieces Finish'd				Remarks

The Engineering Magazine

FIG. 1. MAN-RECORD SHEET AS INTRODUCED AT THE AMERICAN LOCOMOTIVE WORKS IN 1902. These cards must be modified to suit conditions, but this form carries practically all that is ever needed on a time card. Much less will sometimes suffice.

Figure 6 A Machine Record Chart from Work Wages and Profits (1916).

The first set of charts used by Gantt and discussed in 'Work Wages and Profits' were primarily record keeping cards (Fig. 6) and bonus charts (Fig. 7). The key element with both of these charts is information is filled in after the work is completed for a day. The purpose is to identify areas of actual production that need improvement (not to predict future activities).

planning tool used to plan and manage batch production. (Source: European Journal of Operational Research 149 (2003) 430–437: *Gantt charts: A centenary appreciation*, James M. Wilson).

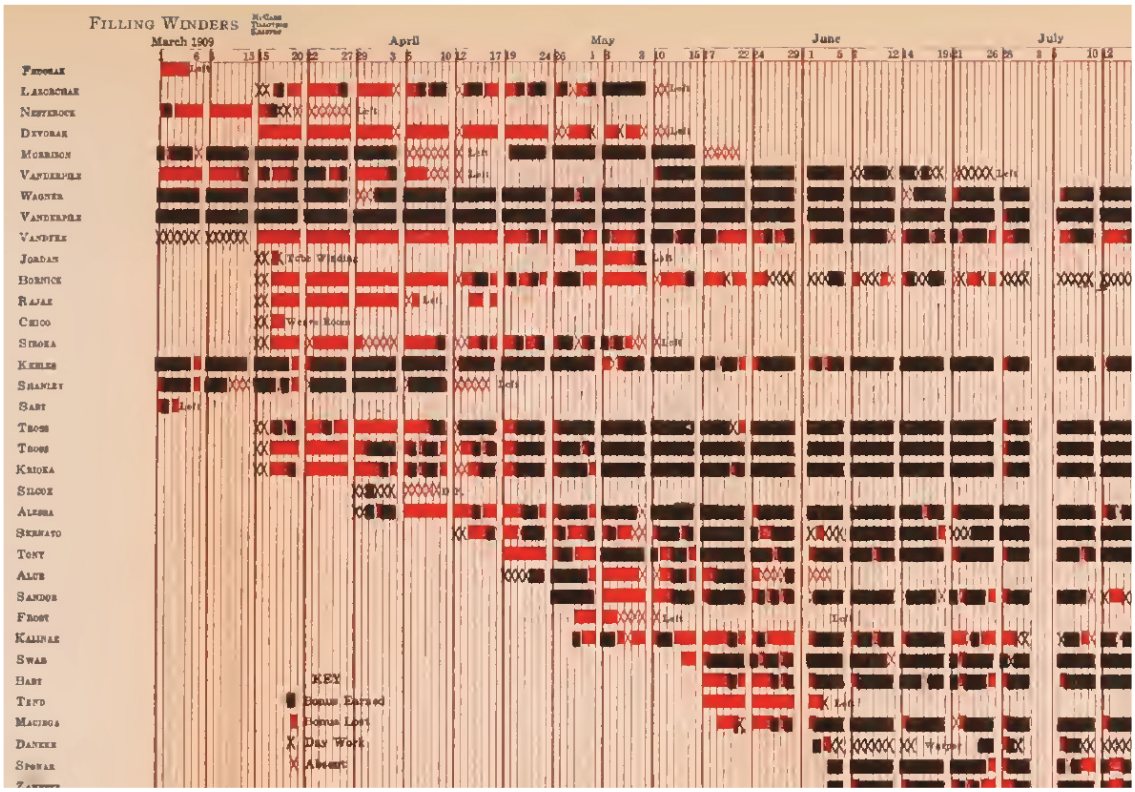


Figure 7 A 'Bonus Chart' information on performance (bonus earned or not) is filled in at the end of each day.

The situation is slightly different in the third chart type discussed in this book. The horizontal red lines on the 'Production Sheet' (Fig. 8) show when work on each specific part is planned to start and finish, the number of parts produced are entered after each day's work to record the actual progress of the worker.

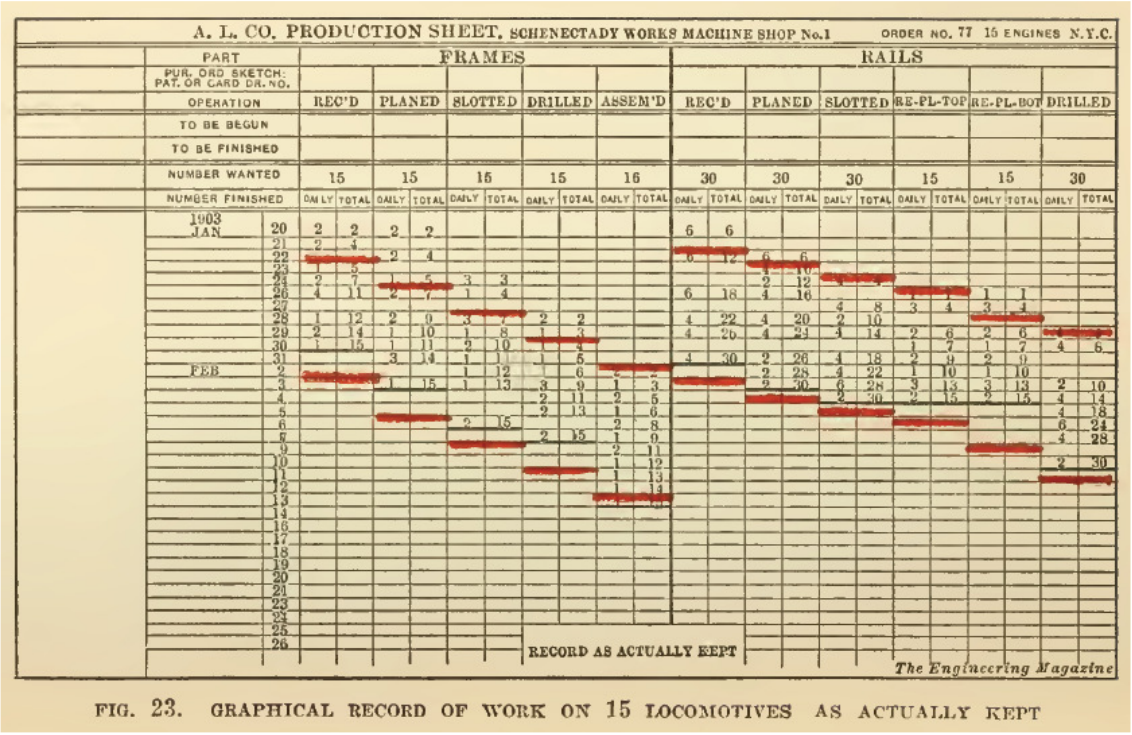


FIG. 23. GRAPHICAL RECORD OF WORK ON 15 LOCOMOTIVES AS ACTUALLY KEPT

Figure 8 A 'Production Chart' the information on actual production is filled in at the end of each day.

'Work Wages and Profits' also includes a number of graphs to demonstrate the effectiveness of Gantt's methods and examples of job cards, time cards and other factory records.

Gantt's second book, 'Organising for Work' published in the year of his death is an interesting read. Henry Gantt knew his working days were nearing an end and he was free to say **exactly** what he thought! Here are a few of his grumpier comments[12]:

- *The most casual investigation into the reasons why so many of the [WW1] munition manufacturers have not made good, reveals the fact that their failure is due to lack of managerial ability rather than to any other cause.*
- *Our most serious trouble is incompetency in high places. As long as that remains uncorrected, no amount of efficiency in the workmen will avail very much.*
- *Our industries are suffering from lack of competent managers,—which is another way of saying that many of those who control our industries hold their positions, not through their ability to accomplish results, but for some other reason.*

Sentiments that I hear quite often today… however, I digress; as in his first book, Gantt uses a range of charts in 'Organising for Work' (1919) to make complex information accessible to workers, supervisors and managers alike. As with the charts above, most of the information is entered after the day's work is completed, and the purpose of charts such as the 'Idleness Expense Chart' is to record inefficient working to allow production improvement efforts to be focused where needed.

However, in 'Organising for work' Gantt does introduce the chart that Wallace Clark calls the 'Gantt Chart' (Henry Gantt always named charts for their purpose). In fact, the name 'Gantt Chart' can be traced directly to the title of Clark's book, 'The Gantt Chart a working tool of management' published in 1923.

Clark worked with Gantt and can be credited for ensuring much of his legacy remains available today. The 'Gantt Chart' used by Gantt and described in detail by Clark shows, for each item to be manufactured, the planned quantity and allocated time slot for manufacturing the 'batch', plus the actual, cumulative, and daily totals all in one line (Fig. 9).

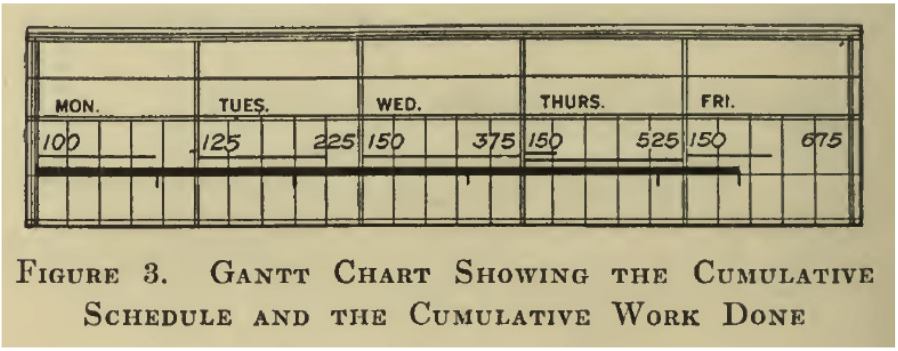


FIGURE 3. GANTT CHART SHOWING THE CUMULATIVE SCHEDULE AND THE CUMULATIVE WORK DONE

Figure 9 The details of a Gantt Chart.

To understand and interpret this chart:

- The heavy black line shows the planned work period (with the required quantity of parts in a tabulation,

[12] Copied from Organizing for Work, p64

- The numbers show the actual quantity produced each day and the cumulative total as at the end of the day.
- The thin line represents the percentage of the day's production achieved (if 100% is achieved, the thin line extends across the full day as on Wednesday),
- The small vertical 'ticks' below the thick black line show the cumulative amount achieved at the end of each day.

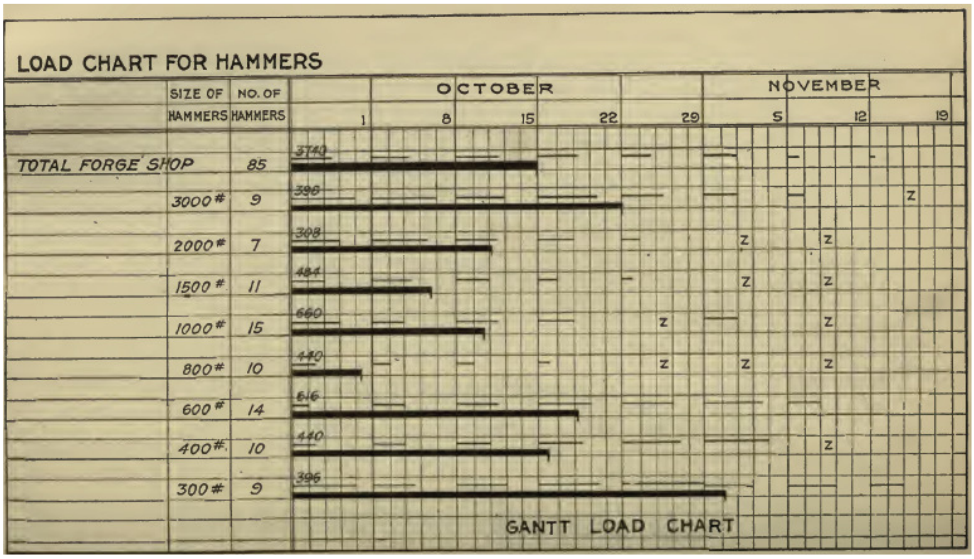


Figure 10 A 'Load Chart'.

As in the example above, the production target can vary from day to day depending on the precise nature of the work, learning curves, re-tooling, etc; and most of the information is entered at the end of each day. Gantt developed and used two variants of this chart, the 'Load Chart' (Fig. 10) and the 'Performance Chart' (Fig. 11).

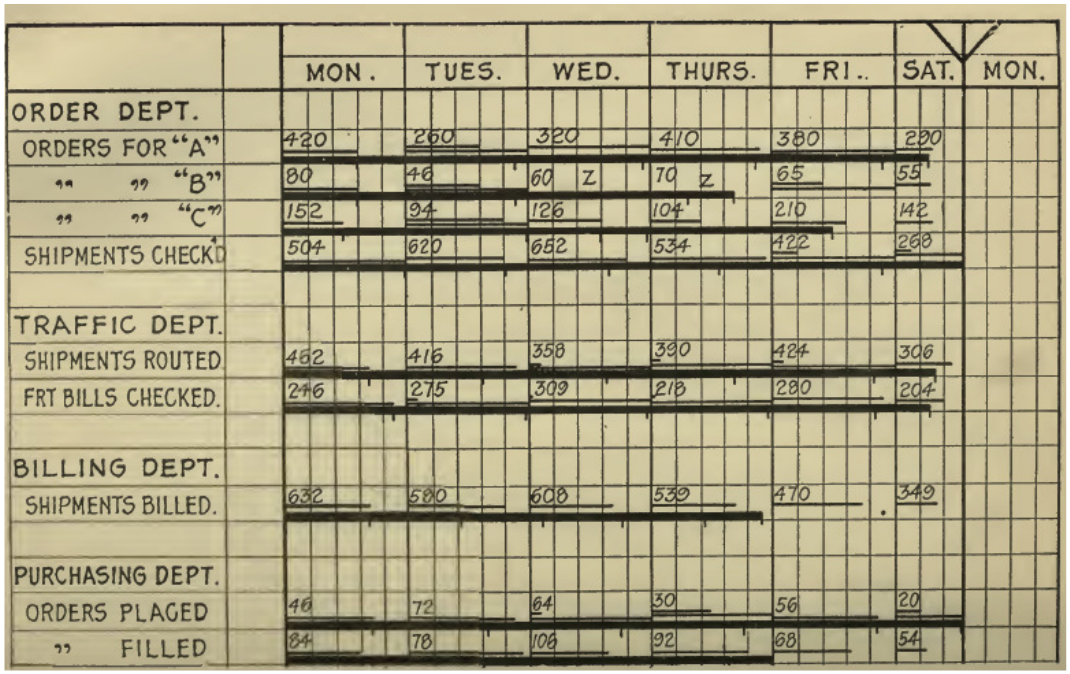


Figure 11 A 'Performance Chart'.

Clark's book goes on to describe many variants of the basic charts outlined above and different way they can be used to assist in machine shop management. Out of all of the various charts developed by Gantt and commented on by Clark, the only one that has any commonality with modern bar charts is the 'Load Chart' which depicts work over time.

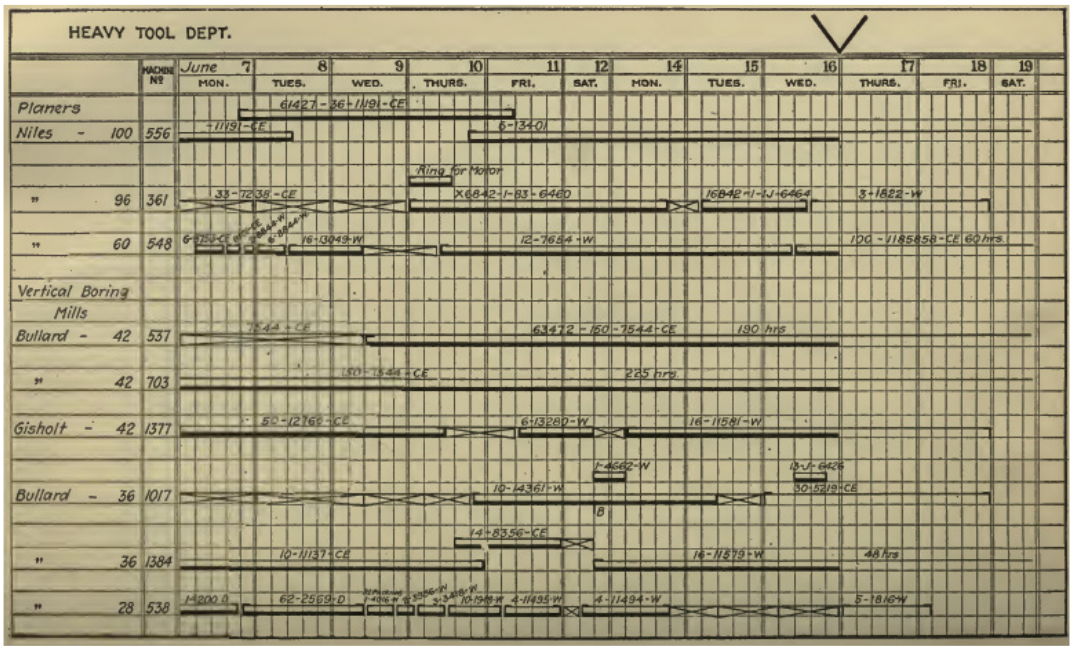


Figure 12 A different type of 'Load Chart' showing planned work over time for each item of equipment.

Clark's book also describes how Gantt's work assisted the American First World War (1917 - 1918) production and mercantile shipping efforts[13] initially at the Frankford Arsenal then on America's entry to the conflict at the Ordnance Department in Washington supporting the work of General William Crozier.

As with his commercial work, the primary focus of all of the charts used by Gantt during the First World War was on charting the difference between promises and performance[14]. As demonstrated above, work planned and work performed is shown in relation to each other and in relation to time[15]. It is interesting to note that after the war General William Crozier was moved on and the charts were quietly dropped as bureaucrats preferred to focus on what that they had done, rather than compare this with what they could have achieved!

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[13] From the Preface: *"In 1917, after a careful inspection of certain factories in which Mr. H. L. Gantt had installed his methods, General William Crozier, then Chief of Ordnance, retained Mr. Gantt to act in a consulting capacity on production, first at the Frankford Arsenal, and then, immediately after the declaration of war, in the Ordnance Department at Washington."*

[14] Dean Schneider discussing Gantt's charts in the Ordinance Dept. *"Each production section has production and progress chart systems. These seem to vary in minor details only. Even without rigid standardization, the charts give a picture of the progress of the whole Ordnance Program including lags and the causes thereof. Combined in one office and kept to date they would show the requirements as to workers, as well as to materials, transportation, accessory machinery, and all of the other factors which make or break the program. With a plan of this sort the Ordnance Department would be in a position to state at any time its immediate and probable future needs in men, materials, transportation, and equipment."* (Organising for Work, pp 80).

[15] The density of information on a 'Gantt Chart', and its function to measure production is far more closely aligned with the concepts embedded in Earned Value than a traditional bar chart. Whilst the style of Gantt's charts is different, the information shown is precisely the same as plotting Earned Value and Planned Value in a modern EV system.

Clark concludes his book as follows:

> ***General Benefits of Gantt Charts***
>
> *In the previous chapters Gantt charts have been shown as:*
>
> *1. A simple and effective method of planning work.*
>
> *2. A way of presenting facts so that they can be easily understood.*
>
> *3. A means of eliminating idleness and waste.*
>
> *4. A method of getting things done on time.*
>
> *But Gantt charts stand for something more than that, for where they have been in use for some time one will find:*
>
> *1. Machines and equipment in good condition.*
>
> *2. Floor space arranged for use; neither cluttered up with unnecessary things nor arranged for appearance only.*
>
> *3. Work moving rapidly from one operation to another without confusion.*
>
> *4. Large reductions in inventories of raw materials, work in process, and finished goods, because of the shortening of manufacturing time.*
>
> *5. Increased production not through speeding up workmen but by removing the obstacles which prevent them from doing their best.*
>
> *6. Reduced costs, because of the elimination of idleness and waste as well as improvements in processes.*
>
> *7. Men in subordinate positions willing to shoulder responsibility instead of "passing the buck," because they have definite duties and clear-cut jobs.*
>
> *8. Courage and initiative stimulated, because men know they will get fair play.*
>
> *9. No favoritism or special privilege, because every man's record can be seen by others.*
>
> *10. Satisfied workmen, because the delays over which they have no control are few and they are left free to do a full day's work and therefore earn better wages.*
>
> *11. Poor workmen trained and developed until they make good.*
>
> *12. Promotions going to men who know their jobs and, therefore, an organization being built up of men who "know what to do and how to do it."*
>
> *13. Men interested in their work, not only because of the wages but because they have an opportunity to increase their knowledge and improve their skill.*
>
> *Seeing such changes take place in one plant after another, watching arbitrary management become democratic and finding workmen not only interested in their work but proud of it, strengthens the conviction that the Gantt chart is the most notable contribution to the art of management made in this generation.*

Sentiments with which I concur; over his life's work Gantt developed progressively more sophisticated charts that made complex information easy to comprehend and use by workers, supervisors and managers alike. But this was is in the management domain of factory/ production management, not project management and the charts are for production planning and production records, they are not 'project management bar charts'.

Henry Gantt's Contribution to Management (not project management):

As discussed above, Henry Gantt's focus was on increased machine-shop production, through the use of effective measurement and planning. The various charts he used were a means to an end: *"The man who undertakes to introduce scientific management and pins his faith to rules, and the use of forms and blanks, without thoroughly comprehending the principles upon which it is based, will fail. Forms and blanks are simply the means to an end. If the end is not kept clearly in mind, the use of these forms and blanks is apt to be detrimental rather than beneficial."*

The starting point of Gantt's work was the ideas of scientific management introduced by Frederic Taylor (Gantt worked with Taylor in the early days)[16]. Scientific management presumes the best way to understand a complex task is to break it down into its component parts, scientifically study and optimise each part and then synthesise the best way to complete the work as a whole, from the optimised parts. What made Gantt's work uniquely valuable was the way this information was used to motivate workers.

Gantt's standout contribution was his innovative approach to workforce management, today we would call this 'team motivation'; overlaid with a strong sense of industrial democracy. His 'method' was focused on the efficient utilization of labour and a fair division of the rewards from any improvement in productivity between the workers and the owners of the factories.

The innovations introduced by Gantt are still very much the focus of modern management; they include team motivation, change management and the effective use of control systems. And whilst the focus of his work was in manufacturing (with the advantage of repetition and standardisation) many of his ideas are of value in today's projects.

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[16] Prior to Taylor introducing the concept of 'scientific management', industrial processes and the management of them were influenced by the pre-industrial revolution ways of working. Businesses were small and independent: the land craftsman toiling away at his workshop bench, the workers determined the process and speed of production. The economic growth of the late 19th century, especially in heavy industries such as railroads and steel required a different economic model. Taylor and his associates, especially Gantt, quickly met this need for a new way of doing things. Taylor invented what became to be known as 'Scientific management', its guiding principles can be summarised as follows:

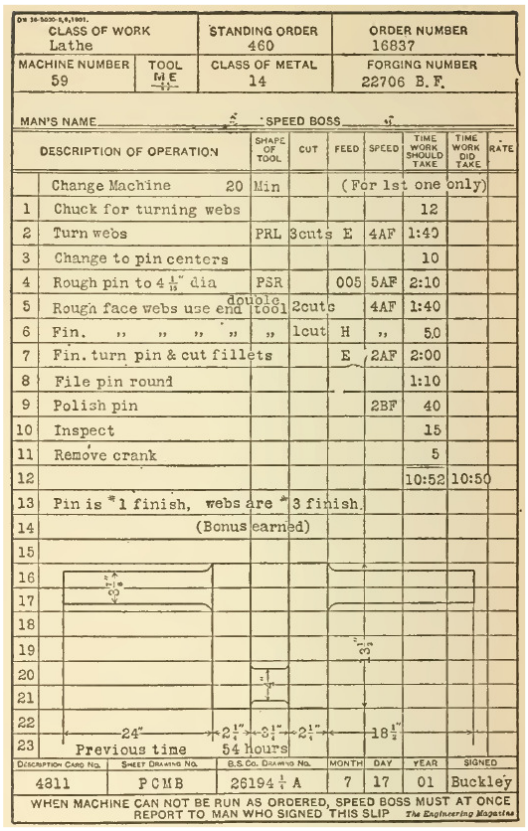
- Separate the labour process from the skills of workers (by simplifying jobs and routing tasks, the work process would be made amenable to a less skilled work force and, to that extent, management would be less dependent on skilled labour – the ideas of Adam Smith and the key underpinning of factory production)
- Measure and optimise each step of the production process – work smarter not harder.
- Separate conception from execution, placing the responsibility for conceptualizing the productive process and planning the work tasks in the hands of management, leaving for the shop floor only the execution of predetermined, rigidly enforced plans
- Monopolize productive knowledge at the managerial level and use this monopoly over knowledge both to centralize decision making and to control every step of the labour process through formal rules and procedures ……

Gantt worked with Taylor for some 30 years and shifted the concept of scientific management from 'forcing' production to 'motivating' production.

These concepts were the central theme of all management thinking until the advent on 'knowledge workers' in the mid 20th century made the 'command and control' approach of scientific management obsolete. As Peter Drucker stated in 1950, managing knowledge workers requires a different paradigm focused on motivating and directing in a collaborative environment.

A contemporary of Gantt, Leon P Alford (1877 - 1942), an American mechanical engineer, organizational theorist, and administrator for the American Society of Mechanical Engineers suggests in his writings that project management was one minor use for Gantt charts. Alford (1924, p. 180), comments that charts: ''*…may be equally valuable when applied to things less concrete … as planning special investigations, and the undertaking of special projects.*''

It seems very unlikely that Gantt used charts as we presently use them (ie, bar charts) in 1917. Alford (1918), remarks: ''*as Gantt realized, the number of rivets driven . . . was a better than fair index to the percentage completion of the ship.*'' Alford comments: ''*. . . he (Gantt) perfected the Gantt chart as a managerial tool, selected rivets driven' as the unit by which to measure progress in the building of ships . . .*'' (Alford, 1934, p. 192) This approach seems consistent with the standard 'Gantt Chart' in Fig. 3 above, and therefore it seems that Gantt did not use his charts as modern project managers do; and, the implications of these remarks is that Gantt may have rejected such a mode of use[17].



CLASS OF WORK: Lathe	STANDING ORDER: 460	ORDER NUMBER: 16837
MACHINE NUMBER: 59 / TOOL: M E	CLASS OF METAL: 14	FORGING NUMBER: 22706 B. F.

MAN'S NAME: SPEED BOSS:

	DESCRIPTION OF OPERATION	SHAPE OF TOOL	CUT	FEED	SPEED	TIME WORK SHOULD TAKE	TIME WORK DID TAKE	RATE
	Change Machine 20 Min			(For 1st one only)				
1	Chuck for turning webs					12		
2	Turn webs	PRL	3cuts	E	4AF	1:40		
3	Change to pin centers					10		
4	Rough pin to 4 1/16" dia	PSR		005	5AF	2:10		
5	Rough face webs use end double tool		2cuts		4AF	1:40		
6	Fin. " " " "	"	1cut	H	"	50		
7	Fin. turn pin & cut fillets			E	2AF	2:00		
8	File pin round					1:10		
9	Polish pin				2BF	40		
10	Inspect					15		
11	Remove crank					5		
12						10:52	10:50	
13	Pin is #1 finish, webs are #3 finish							
14	(Bonus earned)							
15								
16								
17								
18								
19								
20								
21								
22	24" 2 1/4" 3 1/4" 2 1/4" 18 1/2"							
23	Previous time 54 hours							

DESCRIPTION CARD NO.	SHEET DRAWING NO.	B.S. Co. DRAWING NO.	MONTH	DAY	YEAR	SIGNED
4811	PCMB	26194 1/4 A	7	17	01	Buckley

WHEN MACHINE CAN NOT BE RUN AS ORDERED, SPEED BOSS MUST AT ONCE REPORT TO MAN WHO SIGNED THIS SLIP — The Engineering Magazine

Figure 13 A timed job card – the worker was taught how to achieve the 'set times' to earn his bonus.

[17] Another contemporary, discussing operation scheduling for ship building Kimball (1925, p. 149–150) suggests that *"a similar master schedule can be made for each and every large element entering into constructing a ship…."* and goes on in the next section of his book to say: *"it is not uncommon to chart all important events for all work on the master schedule . . . The Gantt chart is perhaps the most effective form of such graphical schedules"* (Kimball, 1925, p. 152). However, none of these actually show a Gantt chart for a project and it is unclear if the author is referring to charts developed by Gantt, or to simple bar charts.

Alford, L.P., 1918. An industrial achievement of the war. Industrial Management 55 (2), 97–100.

Alford, L.P., 1924. Management's Handbook. The Ronald Press Co., New York.

Alford, L.P., 1934. Henry Laurence Gantt: Leader in Industry. The American Society of Mechanical Engineers, New York.

Kimball, D.S., 1925. Principles of Industrial Organization. McGraw-Hill Book Company, Inc., New York.

The centrepiece of Gantt's method involved the scientific investigation and careful standardization of the work into tasks. Figure 13 shows a task card with set processes and times to manufacture a heavy metal 'pin'. Once a task had been 'set' by an expert[18], the expert was required to provide individual instruction to each worker on how to accomplish the task, and once they had learnt to perform the task in the set time and to the required quality, a bonus was paid in addition to their daily wage.

Gantt recognised incentives are a far more powerful motivator then penalties. He described his approach as *"a system of education for the workforce, with a bonus for those who learned!"* It proved highly effective generating sustained productivity improvements well in excess of 100%.

Gantt's system also interconnected the reward paid to the supervisor with the rewards paid to the workers. The foreman received a bonus for each worker in his team that received a bonus, but the foreman's bonus was doubled if all of the workers in his team achieved a bonus. This encouraged the foreman to ensure his shop operated efficiently and to work with and support the least effective members of 'the team' to bring everyone up to standard. Importantly whenever a bonus was not earned, the cause was investigated and the cause of the failure removed or remedied, Gantt wanted everyone to make their bonus every day! He knew that when this was achieved, the plant as a whole was working to its optimum productivity level and generating the maximum profits; a win-win outcome for everyone.

Gantt was also aware of the challenges of 'change management'. When introducing his system to a new factory, he recognized that *"in every workroom there is a fashion, a habit of work, and every new worker follows that fashion, for it isn't respectable not to."* Consequently, *"the changing of a system of management is a very serious matter and cannot be done by a superintendent in his spare time."*

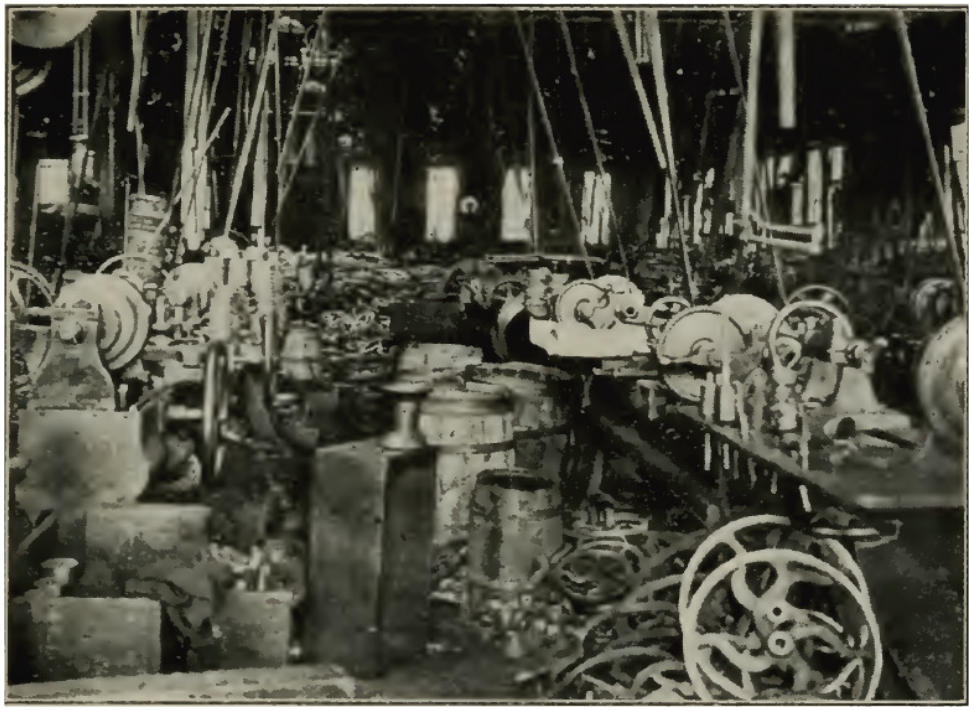


Figure 14 Before improvement.

[18] 'Setting a task' involved an experienced and skilled workman determining the best way to accomplish the work and the optimum time needed for each step in the process.

The effort needed to introduce Gantt's system required a high degree of skill, took time, required on-going support, and needed planning!

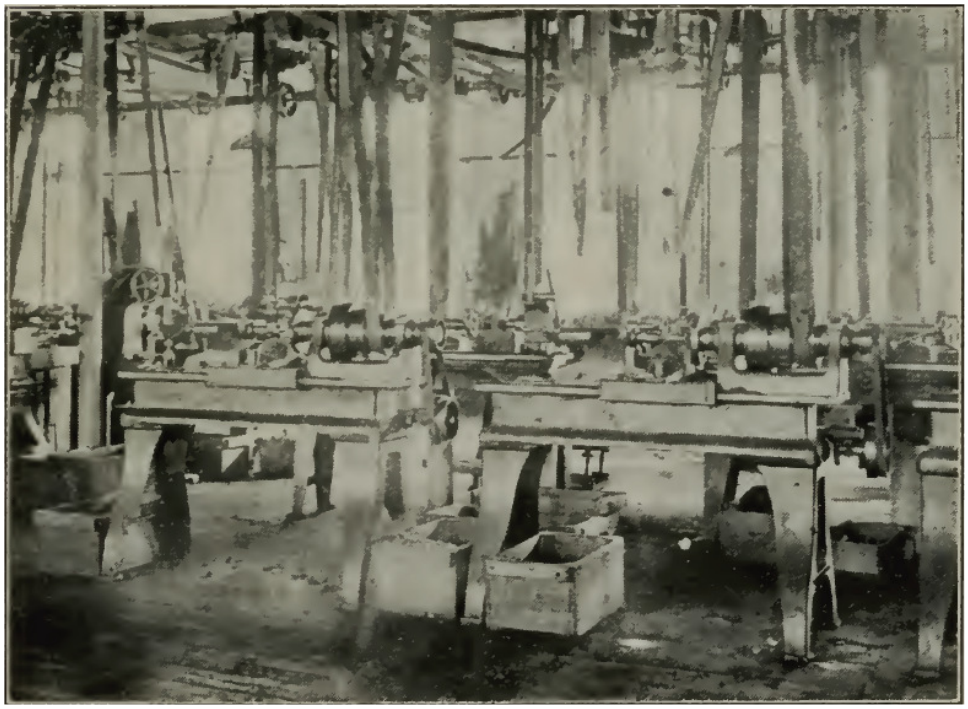


Figure 15 After improvement.

Gantt's starting point was the physical layout of the workplace. The photographs in Figures 14 and 15 are the same factory work-space before and after Gantt's involvement. Before introducing the bonus system, he wanted to make sure the workers could be successful!

Gantt also recognised these improvements required the active involvement of a skilled and committed management. He was highly critical of ineffective management focused on short-term profits! *"No ...laws.... have so far been framed that restrain the "high financier" who, without giving anything in return, taxes the community for his own benefit to an extent that makes all other forms of acquiring without giving an adequate return seem insignificant."*

Gantt's method focused on balancing the whole production system, he recognized that a *'system of management requires all of its parts to work in harmony if it is to be effective, and this requires trained workers'* supported by skilled supervisors and managers. He understood that management was ultimately responsible for the efficient utilization of labour and implementing efficient systems that minimized errors (the focus of modern systems and quality engineering).

Gantt also recognised that to make the changes permanent, both parties needed to benefit and be satisfied with the outcomes for optimum productivity to be achieved, leading to the maximum payment of bonuses and the generation of enhanced profits long-term; this meant management needed to share the reward with the workers – *industrial democracy*.

Henry Gantt Conclusion[19]:

Henry L. Gantt was a fascinating pioneer of modern management practice, much of his work still has an important place in project management as much as any other sphere of management.

- He focused on motivation over 'driving' workers: *"The general policy in the past has been to drive, but the era of force must give way to that of knowledge, and the policy of the future will be to teach and to lead to the advantage of all concerned"*.
- He recognised the advantages of minimum inventory, clean work places and quality decades before 'lean' and 'six sigma' were thought of.
- He also introduced a wider social responsibility in his teachings*: "The business system must accept its social responsibility and devote itself primarily to service ... of the community's needs"*.

The management aspects of Gantt's work have only been briefly discussed in this paper although they are the central theme of both of his books. However, with respect to the two myths highlighted at the beginning of this paper I hope you agree they are thoroughly 'busted'!

- This paper has clearly demonstrated that the concept of bar charts pre-date Gantt's work by 100 years (at least).
- We have also shown from Gantt's own books his focus was on factory management and batch production, he had absolutely no involvement in developing the concepts of 'project management'.

Gantt's contributions to the advancement of management science are of great significance, we do not need to diminish them by associating him with simple time focused bar charts, even if during the 1930s lazy American managers dropped most of the sophistication embedded in a true 'Gantt Chart' and started calling any time scaled chart a 'Gantt Chart'[20] and then in the 1950s and 60s, even lazier scholars blindly accepted the name as being synonymous with a bar chart, without doing some basic research into the man, his charts or the true origins of bar charts.

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[19] These conclusions are supported by academic research, see: Joana Geraldi, Thomas Lechter, (2012)*,* ***"Gantt charts revisited: A critical analysis of its roots and implications to the management of projects today"***, International Journal of Managing Projects in Business, Vol. 5 Iss: 4 pp. 578 – 594. their findings are:

"We had hoped to find in the original work of Gantt some hints as to the uncertainty of projects, some tips or wisdom on the use and limitations of Gantt chart that have been lost in the development of knowledge over the years. What we found though was that Gantt developed his methods for repetitive routine operations.

Gantt was a prolific writer and had an impressive intellectual productivity, he has published over 150 titles and three major books: "Works, Wages and Profits", "Industrial Leadership" and "Organizing for Work". He also patented over 12 inventions, has made numerous presentations in the American Society of Mechanical Engineers and lectures at Stevens, Columbia, Harvard and Yale. So it could well be that among this large body of work, he had mentioned other contexts apart from repetitive operations; we do know that he has studied project-like activities too such as the production of ships. However, we can assert that repetitive operations were his key concern in all three books. He was, as much as Taylor, concerned with the efficient and effective use of resources and increase of productivity in repetitive, routine operations through rational, Scientific Management of work."

However, the authors seem to be unaware of the earlier development and use of bar charts referenced in this paper and continue the probably false assertion that Henry Gantt developed bar charts or probably to be more accurate, Gantt Charts and bar charts are synonymous, which I believe we have demonstrated is not the case.

[20] Other names were also used, see: Muther, R. (1944), *Production-line Technique*, McGraw-Hill, New York, NY. Muther described modern bar charts *"for the first time"* called schedule charts.

You don't have to accept my views on this, all three books are short, interesting to read and can be downloaded from: https://mosaicprojects.com.au/PMKI-ZSY-025.php#Process1

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