JOURNAL FOR INNOVATIVE DEVELOPMENT IN PHARMACEUTICAL AND TECHNICAL SCIENCE
Volume-2,Issue-1 (Jan-2019)
ISSN (O) :- 2581-6934

Development of processes using motion study in production industries

Neeraj Kumar Sharma[1]
[1]Head of Department, Mechanical Engineering, SITM, Lucknow, India

Abstract:- The Gilbreths pioneered manual motions and developed basic laws of motion economy that are still relevant today.They were also responsible for the development of detailed motion picture which are extremely useful for analyzing highly repetitive manual operations.Motion study is a technique of analyzing the body motions employed in doing a task in order to eliminate or reduce ineffective movements and facilitates effective movements for developing processes.By using motion study and the principles of motion economy the task is redesigned to be more effective and less time consuming.In a broad sense, motion study encompasses job simplification so that it is less fatiguing and less time consuming. It is a graphic representation of an activity and shows the sequence of the therbligs or group of therbligs performed by body members of operator.It is drawn on a common time scale.In other words, it is a two-hand process chart drawn in terms of therbligs and with a time scale.On analysing the result of several motion studies conducted,Gilbreths concluded that any work can be done by using a recipe of some or all of seventeen fundamental motions, called therbligs .These can be classified as effective therbligs and ineffective therbligs. Effective therbligs take the process progress towards completion.

Key words:Motion economy,therbligs,process,operator

I.INTRODUCTION

Industrial engineering terminology, published by the American Society of Mechanical Engineers, gives separate definitions for motion study, the latter being confined to hand and eye movements at the workplace.It does the improvement of factory,shop and workplace layout and of the design of plant and equipment, economy in human effort and the reduction of unnecessary fatigue, improvement in the use of materials, machines and manpower,the development of a better physical working environment.There are a techniques suitable for tackling problems on all scales from the layout of complete factories to the smallest workers on repetitive work. In every case, however, the method of procedure basically the same and must be carefully followed. In examining any problem there should be a definite and ordered of analysis.Such a sequence may be summarised as follows.Define the problem,obtain all the facts relevant to the problem, examine the facts critically but impartially,consider the courses open and decide which to follow,act on the decision,follow up the development.The basic procedure for method study, selecting the steps.They are as follows.Select the work to be studied,record all the relevant facts about the present method by direct observation.Check up those facts critically and in ordered sequence using the techniques best suited to the purpose,develop the most practical, economic and effective method,having due regard to all contingent circumstances.Describe the new method so that it can always be identified,install that method as standard practice, maintain that standard practice by regular routine checks.Do not be deceived by the ease of the basic procedure into thinking that method study is easy and therefore unimportant.On the divergent, method study may on instance be very complex, but for purposes of description it has been condensed to these few simple steps.

When considering whether a method study investigation of a particular job should be carried out certain factors should be kept in mind.These are economic considerations, technical considerations, human reactions. Obvious early choices are bottlenecks which are holding up other production operations;movements of material over long distances between shops, or operations involving a great deal of manpower and equipment; operations involving repetitive work using a great deal of labour and liable to run for a long time.Economic considerations will be important at all stages. It is visibly a waste of time to set up or to persist a long investigation if the economic importance the job is small, or if it is one which is not expected to run for long.The initial questions must forever be:Will it reimburse to commence a method study of this job?, and Will it pay to prolong this study?A machine tool constituting a bottleneck in production is known to be running at a speed below that at which the high-speed cutting tools will activate effectively.Can it be speeded up, or is the machine itself not robust enough to take the faster cut? This is a problem for the machine. tool expert.The loading of unfired ware into ovens in a pottery.A change in method might bring augmented productivity of plant and labour, but there may be technical reasons why a change should not be made.This demands advice of a specialist in ceramics.Method study will be more readily accepted by the workers if the first subjects selected are ones which are unpopular, such as dirty jobs or those calling forifting of heavy weights.If these jobs can be perked up and the objectionable features removed from them method study will be seen to be reducing the effort and fatigue of the workers and will be welcomed accordingly.Human reactions are among the most difficult to foretell,since mental and emotional reactions to investigation and changes of method have to be anticipated.Experience of local personnel and local conditions should reduce the difficulties.Trade union officials, workers' representatives and the operatives themselves should be instructed in the general principles and true objectives of method study.If,however, the study of a particular job emerges to be foremost to turbulence or ill-feeling leave it alone, however hopeful it may be from the economic point of view.If' other jobs are tackled successfully and can be seen by all to benefit the people working on them opinions will change and it will be possible, in time,to go back to the original choice.When selecting a job for method study it will be found helpful to have a standardised list of points to be covered.This prevents factors being and enables the suitability of different jobs to be easily compared.The range of jobs which may be tackled by method study in any factory or other place where materials are moved or manual work is agreed on (including usual office work) is generally a very wide one.

The most commonly used of these recording techniques are charts and diagrams.There are several different types of standard charts available, each with own special purpose.Charts indicating process sequence are outline process chart, flow process chart man type, flow process chart material type, flow process chart equipment type, two handed process chart.Charts using a time scale are multiple activity chart,simo chart,P.M.T.S. chart.Diagrams indicating movement are flow diagram,string diagram,cyclegraph, chronocyclegraph,travel chart.Those which are used to record a process sequencethat is, a series of events or happenings in the order in which they occur but which do not depict the events to scale; and Those which record events, also in sequence, but on a time scale, so that the interaction of related events may be more easily studied.Diagrams are used to indicate movement more clearly than charts can do. They usually do not illustrate all the information recorded on charts, which they supplement rather than replace.Among the diagrams is one which has come to be known as the Travel Chart, but despite its name it is classed as a diagram.The next step in the basic procedure, after opting for the work to be studied, is to record all the facts regarding the existing method.The success of the whole procedure depends on the accuracy with which the facts are recorded, because they will provide the basis of both the critical examination and the development of the improved method.It is therefore indispensable that the record be clear and concise.The usual way of recording facts is to write them down.Unfortunately this method is not suited to the recording of the complicated processes which are so common in modern industry.This is predominantly so when an exact record is required of every minute detail of a process or operation.To describe exactly everything that is done in even a very simple job which takes perhaps only a few minutes to perform would probably result in several pages of closely written script,which would require careful study before anyone reading it could be quite sure that had grasped all the detail.The recording of the facts about ajob or operation on a process chart is greatly facilitated by the use of a set of five standard' symbols, which together serve to represent all the different types of activity or event likely to be

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encountered in any factory or office.They thus form a very convenient, widely understood type of shorthand, saving a lot of writing and helping to show clearly just what is happening in the sequence being recorded.Operation indicates the main steps in a process, method or procedure.Usually the part, material or product apprehensived is customized or altered during the operation.It will be seen that the symbol for an operation is also used when charting a procedure, as for instance a clerical routine.An operation is said to take place when information is given or received, or when planning or calculating takes place.Inspection indicates an inspection for quality and/or a check for quantity. Often a more detailed picture will be required than can be obtained by the use of these two symbols alone.In order to achieve this three more symbols used.Transport indicates the movement of workers, materials or equipment from place to place.A transport thus occurs when an object is moved from one place to another, except when such movements are part of an operation or are caused by the operator at the work station during an operation or an inspection.This symbol is used whenever material is handled on or off trucks, benches, storage bins, etc.Temporary strage or delay indicates a delay in the sequence of events: for example, work waiting between consecutive operations, or any object laid aside temporarily without record until required.Storage indicates a controlled storage in which material is received into or issued from a stores under some form of authorisation; or an item is retained for reference purposes.The questioning technique is the means by which the critical examination is conducted, each activity being subjected in turn to a efficient and progressive series of questions.The questioning sequence used follows a well-established pattern which examines the purpose for which,the place at which,the sequence in which,the person by whom,the means by which.The secondary questions cover the second stage of the questioning technique, during which the answers to the primary questions are subjected to further query to determine whether possible alternatives of place, sequence, persons and/or means are viable and preferable as a means of improvement over the existing method. Thus, during this second stage of questioning, having asked already, every activity recorded, what is done and why is it done, the method study goes on to inquire what else might be done? And, hence: What should be In the same way, the answers already obtained on place, sequence, person means are subjected to further inquiry.Combining the two primary questions with the two secondary questions under each of the heads: purpose, place, etc.

The first step. in doing so is to build a record of the proposed method on a flow process chart so that it can be compared with the original method and can be checked to make sure that no point has been overlooked.There is an old saying to the effect that to ask the right question is to be half way to resulting the right answer.This is specially correct in method study.From the very brief example of the use of the questioning sequence given above it will be seen that once the questions have been asked most of them almost answer them. Once the questions- What should be done? Where should it be done? When should it be done? Who should do it? How should it be done? have been answered, it is the job of the method study man to put his findings into practice. It will be seen from the summary that there have been considerable reductions in the number of "non-productive" activities.The number of "operations" has been reduced from four to three by the abolition of the unnecessary cleaning and the inspection carried out directly after it has also been eliminated.

II.LITERATURE REVIEW

No one worked more industriously in this effort than Frank and Lillian Gilbreth, and no one was more conscious of the intimate relationship between the manufacture and the marketing of an innovative product.Even as large-scale enterprises increasingly integrated the manufacture and marketing of mass-produced goods in the late 19th and early 20th centuries, scientific managers elaborated and popularized their efficiency methods and strategies in an attempt to carve out a distinctive scientific professional niche within the changing industrial world.Definitely, my central argument is that the Gilbreths' fame and reputation is due less to the inherent quality of their motion study techniques, or to their achievements in practical motion study and scientific management installation, than to their prolific efforts to publicize both themselves as humane scientists and their principles and techniques as favorable to greater efficiency and workplace harmony. In reality, in a period characterized by rapidly changing business dynamics

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and troubled labor-management relations, the Gilbreths found that their motion study methods, though sound in theory, at best formed only partial and temporary efficiencies in practice, and more often than not exacerbated tensions,not only between the workers and managers they were supposed to reconcile, but also among scientific managers themselves.Ultimately, the Gilbreths simply were less successful as manufacturers than as marketers of their motion study strategies. That their strategies and techniques endured and flourished is testimony less to their intrinsic worth as they practiced them than to the image of their worth which the Gilbreths carefully cultivated.Prior to his celebrated meeting with Frederick W. Taylor in December 1907, Frank Gilbreth had acquired renown as an innovative building contractor.His repute was based on speed work achieved by mechanical innovations (an adjustable bricklayer's scaffold and cement mixers),systematic management (coordinating activities on and among construction sites, generating labor efficiency), and advertising publicity employing glossy pamphlets replete with photographs, many of them chronological images displaying his buildings in progressive stages of completion.Gilbreth did not approach Taylor as a nail, consequently, but rather as one who saw himself with as much to teach as to learn. Thus,even as he read Taylor's works and employed his acolytes to introduce time study for task and piece rate setting on his building sites, Gilbreth began putting into deed new bricklaying methods, publishing them in his bricklaying system with the announcement that,The motion study Gilbreth instated was dependent initially on simple trial-and-error methods.Thus, in renovating bricklaying methods he used his adjustable scaffold to keep his workers level with the, wall they built so as to eliminate the motion of stooping; he agreed mortar and bricks to eliminate reaching; and he cut down the labor process so that a bricklayer could repetitiously grab a brick and trowelful of mortar simultaneously, swivel, and simultaneously deposit mortar in the furthest tier of bricks and the brick in the next closest.Thus he asserted to reduce the bricklayers' motions from as many as 18 to as few as 4-1/2.Gilbreth's achievement gained him considerable public acclaim but the acclaim was by no means universal.Brick masons in fastidious reacted to Gilbreth's usurpation of their prerogatives and struck his sites twice.To build matters worse, Gilbreth's motion-studied efficiencies failed to aid his company's financial stability.At the very moment that his integration of systematic management, time study for piece rate setting, and motion study for labor efficiency gave him the potential to gain control of all on-site work, the edifice melancholy of the winter of 1911-12 threatened him with bankruptcy.Accordingly, because he felt that in motion study he had a significant tool with which to solidify his own reputation within the rising scientific management movement,Gilbreth chose this time to build his career move, exiting the construction industry and dedicating himself to his own version of Taylorism.Gilbreth's career transition occurred at a propitious time. Louis Brandeis' endorsement of scientific management efficiencies as an antidote to railroad rate increases in the 1910 Eastern Rates Case raised Taylorism's public profile, while the subsequent trade union antagonism to scientific management highlighted by the Watertown Arsenal strike in 1911, served to provide the scientific managers with opportunities to explain themselves before an aroused national audience.Given Taylor's use of Gilbreth's bricklaying innovations as illustrations for his popular Principles of Scientific Management, and the American Federation of Labor's singling out of motion study for special disapprobation,Gilbreth had a special pledge in defending scientific management and in maneuvering his motion study brainchild more firmly before Taylor's attention. On Taylor's behalf,Gilbreth participated in public debates with trade unionists on scientific management, while Lillian Gilbreth compiled The Primer of Scientific Management to address a popular audience by responding the most common questions about Taylorism.She went on in Psychology of Management to argue that scientific management, contrary to union claims, was the only management method consonant with the 3 psychological health and development of workers. In the meantime Frank Gilbreth planned the Society for the Promotion of Scientific Management, giving the beleaguered Taylorites a forum for mutual support, self-defense, and the promotion of their principles. Through such activities the Gilbreths not only executed a service for Taylor but also identified Frank Gilbreth as a leading exponent of the new managerial science.However, after having put on Taylor's approval, when he undertook his

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own installation career at the same time as making considerable improvements in motion study techniqueGilbreth revived Taylor's suspicions and created the conditions for his mentor's alienation.Gilbreth commenced his installation career at the New England Butt Company of Providence,Rhode Island, armed with a new motion study technique he called micro-motion study. Micro-motion study implicated filming a worker's operations against a cross sectioned background while a chronometer within the motion picture camera's field of vision counted time.By probing the film through a magnifying glass,Gilbreth could determine the times of the worker's motions to the one-thousandth of a second while measuring the length of those motions against the background.He could then contrast methods,alter work conditions, and synthesize the best elements of motion into a method which would become standard for that job.Gilbreth saw micro-motion study as a potent remedy to labor hostility as well as a major advance over stop-watch time study. The unions indictd that time study, despite its scientific pretensions, was merely a tool of management designed to speed up the pace of production.Gilbreth contradicted that micromotion study, by replacing the subjective time-study man and his stop watch with the objective eye of the camera and chronometer, provided meaningful scientific accuracy in observing and timing work operations.He further asserted that the more efficient work methods derived from micromotion film analysis meant increasing production by eliminating unnecessary and inefficient motions and substituting more productive ones, lashing up output by greater worker effectiveness, rather than by faster speed. Even as the Butt Company installation developed ,Gilbreth went to work at publicizing micro-motion study as an advance over time study and as an advantage to workers.Claiming that his new technique revolutionized braider machinery assembly processes and increased output per assembler from 11-12 to 60 machines per day, Gilbreth arranged to unveil his discovery at the American Society of Mechanical Engineers gathering in December 1912 before an audience including Taylor and most of his disciples.There, R.T. Kent entitled micro-motion study "as revolutionary in the art of time study as was the invention of the power loom in the art of weaving". Gilbreth's revelation did not please Taylor. Indeed, in his own presentation Taylor responded by redefining time study by incorporating Gilbreth's motion study ideas, though not endorsing his specific techniques.What Taylor did not know and what Gilbreth did not own up was that the most important facets of braider assembly redesign at the Butt Company were determined by straightforward observation before Gilbreth's micromotion laboratory had been inclusived, that the greatly increased output per assembler had been achieved by assigning time-consuming elements of the process to other workers, and, finally, that because he could not arrange powerful enough mock lighting to overcome the factory gloom, Gilbreth was almost totally reliant on stop-watch time study for piece rate setting . In short, at the time that Gilbreth broadcasted its virtues, micro-motion study had not yet lived up to a single one of them.Gilbreth nevertheless achieved a public relations coup.Although he could only fall further afoul of the trade unionists, who already saw motion study as a tool for creating automatons,Gilbreth pressed home his image as an innovator, popularizing his new technique by using it to time the fastball speeds of pitchers at baseball games and engaging an academic audience by inducting a series of Summer Schools of Scientific Management for college professors in destiny beginning in 1913. Gilbreth continued innovating. While studying the motions of handkerchief folders for the Herrmann-Aukam Company of South River, New Jersey, Gilbreth invented additional motion study techniques which he dubbed cyclegraphs, chronocyclegraphs, and stereochronocylegraphs, all devised for the analysis of minute, fast worker motions.The basic cyclegraph method involved mounting a miniature electric light on a ring that could be slipped onto a worker's finger, showing up on the back of the hand.The movement of the light generated a bright line on a single time-exposed photograph. A line packed of twists and turns bespoke inefficient movement.The worker's tools, equipment, and motions could then be altered until the shortest, smoothest line was developed. Gilbreth perked up on the cyclegraph motion map by interrupting the flow of current so as to obtain,in the resulting sequence of flashes, a record of the time and direction of the motions under observation.The resulting image was a chronocyclegraph.A stereochronocyclegraph produced a three-dimensional image of motion by using time-exposed

ISSN:- 2581-6934 |www.jidps.com

photographs from two slightly off-set cameras, the positives from which could be viewed through a stereoopticon or stereoscope.With his usual eye for publicity, Gilbreth arranged for Fred Colvin of the American Machinist to break the news of his latest advances to the engineering world.Though Gilbreth became identified as Taylor's nearly all scientific and innovative follower,he managed through his practical installation work only to increase Taylor's distrust.At a time when trade union militancy beside scientific management was at a peak, Gilbreth had to employ carrot and stick diplomacy at the Butt Company to avert a strike by workers influenced by the IWW and AFL, an occurrence which gravely undermined Taylor's faith in Gilbreth's abilities. Matters between the two came to a head due to Gilbreth's handling of his contract with Herrmann-Aukam Company in 1913-14.Gilbreth took the job to exercise his chronocyclegraph techniques on the detailed motions required in handkerchief folding and packaging.But he quickly diverted his attention to building his reputation abroad when he gained a contract to install scientific management at the giant Auergesellschaft electric light and gas mantle manufacturing company in Berlin. In Gilbreth's absence the Herrmann-Aukam owners broached Taylor with complaints about the pace and quality of Gilbreth's work.Taylor recommended that his orthodox disciple, H.K. Hathaway, finish Gilbreth's job, a signal of disapprobation so severe that Gilbreth took it as a declaration of war. Gilbreth's response was immediate and thoroughgoing, heralding an abrupt shift in his image-management tactics.From Germany he engraved Lillian Gilbreth,"We must have our own organization and we must have our own writing so made that the worker thinks we are the good exception".Becoming the good exception, however, required considerable maneuvering. Severing his relations with Taylor meant cutting himself off from all mainstream scientific managers and generating a relatively distinctive profile as an independent efficiency expert. That scientific management was then under performanced federal government scrutiny due to the AFL-backed International Association of Machinists efforts to have Taylorism banned in government arsenals and navy yards clarified Gilbreth's task.To deal with potential negative publicity stemming from Taylor and his disciples,Gilbreth immediately decided to keep all information about his present and future installation work secret, sacrificing potential publicity for security against claims of incompetency.Second, he began rewriting his autobiography. Having to this point emphasized his debt to Taylor's ideas for his own development of motion study, Gilbreth now sought to create a convincing version which would show that he invented motion study independent of and prior to his contact with Taylor. Damage control was simpler for Gilbreth than creating a new, positive public profile. That Taylor died in 1915 did not moderate the energy the Gilbreths applied to the task. If anything it focussed them more clearly, for with Taylor out of the way the battle was on for who could most fittingly step into the leadership of the efficiency movement. Fortunately, by the time Frank Gilbreth returned from Germany, Lillian Gilbreth had inclusived two book-length manuscripts with which to launch his new image.To become the good exception among scientific managers, Lillian Gilbreth recommended emphasizing both Gilbreth's concern with the "human factor" and his scientific outlook.This meant arguing, contrary to the trade unionists, government commissions, and Robert Hoxie, that motion 6 study particularly, and scientific management generally, increased industrial output in ways which improved and did not detract from the worker's mental and physical strength and individuality.Accordingly, Lillian Gilbreth's first manuscript, published as a series of articles in Iron Age in 1915-16 under both of their names, dealed with the problem of the troublesome "human element."Her prime conflict was that motion study was less a series of mechanical devices for advancing output than a systematic program for the development and betterment of the worker.Motion study aimed to train workers rather than to demolish skill. Motion study was, in core, to be educated and internalized by the workers who, pertaining its principles, could befall skilled motion study experts in their tasks and valuable aids to management, not mere slight specialists in a craft or unexciting machine tenders.That is, she intended that as motion study normalized work processes, practices based on the motion study way of considering would become the foundation of new worker skills for which they would be individually contented by piece rate wages and promotion.Lillian Gilbreth bickered in Fatigue Study that the aim of motion study specialists was to find out

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accurately the fatigue resulting from any job, then to eradicate that which was unnecessary by designing convenient workbenches, furnishing chairs, providing regular rest-recovery periods, and so on.In short, as the facade of the motion study coin, fatigue study enhanced efficiency so as to reveal its benefits to workers in a tangible way.Fatigue study also had strategic and psychological value.By the stage a fatigue survey on first entering a factory, by providing swift antidotes to evident fatigue-producing activities like standing and stretching,and by swaping traditional skills with motion study skills, Lillian Gilbreth whispered that the scientific manager and motion study engineer bettered the chance of acceptance by workers.Such vision, backed by an appropriate declaration of intentions, enhanced by an immediate fatigue survey,and reinforced by such basic industrial betterment techniques as open meetings to converse installation progress was meant to equip reality to industrial welfare leader H.F.J. Porter says that,“Men can simply be escorted and they will then be instilled with a better spirit than when they are being driven”.Lillian Gilbreth’s writings enabled her husband to play a double gambit.To workers and industrial relations and betterment experts,Gilbreth could take part in the fatigue study card, contending that motion study humanized work conditions and facilitated industrial peace.To owners, managers, and efficiency experts, Gilbreth could slant the motion study card, arguing that he could boost output by applied motion study science.To assist in the latter Gilbreth had a final motion study innovation.By 1915 he had determineed the basic alphabet of all work motions, naming them therbligs.All work motions, he contended, could be reduced to a mere seveteen varieties: search, find, select, grasp, position, transport loaded, assemble, use, disassemble,inspect, preposition (for next operation), release load, transport empty, wait (unavoidable delay), wait (avoidable delay), and rest (for overcoming fatigue).Assemble, use, and disassemble could be resolved into the other therblig units, on condition that an extremely detailed analytical breakdown of any operation.By evaluating micro-motion film or chronocyclegraphs, the therbligs could be identified and plotted on simultaneous motion (simo) charts.The simo chart cataloged horizontally the parts of the body – arms, legs, trunks, and head – with subdivisions (for example, arm could be dissected into upper and lower arm, wrist, thumb, fingers, and palm).The vertical axis displayed elapsed time.By conveying each therblig a color and symbol, Gilbreth could chart each body part’s fundamental motion against time, producing a clear visualization of the relationships between the therbligs employed in any job.Simo charts enabled Gilbreth to discriminate whether, for instance, one arm was actively working while the other was merely passive during the motion cycle.If so, he could revamp the operation with an eye to actively employing both arms simultaneously while shortening the times for movements made by placing tools and parts closer to the worker’s grasp.Therbligs were a stunning advance, providing Gilbreth with a superb analytical tool and bolstering his confidence in the validity of his pursuit of a science of motions.Evenly important for their public demeanor, the Gilbreths returned then to an attack on time study and a promotion of motion study as a science.They made clear in Applied Motion Study that they, not Taylor’s orthodox disciples, inherited his concern with the science in scientific management.To cap off their reprofiling blitz, the Gilbreths came up with a snappy jingle which unified their concern with the human element and their unease with the scientific analysis of work processes.They were, they uttered, on “the pursuit of the one best way to do work”.Gilbreth completed his discovery public in a paper for a local New York ASME meeting in the winter of 1915-16, entitled“Motion Study for the fighter,” set up possibly his nearly all fundamental motion study discovery within a paper whose professed focus, the healing of handicapped war veterans, undermined the likelihood of critique.The Gilbreths held this profile without discernibled amend despite significant alterations in the worker-management environment.After World War I the AFL and the Taylor Society (as the SPSM was renamed arrive at a rapprochement engineered largely by industrial relations experts like Robert G. Valentine, who squabbled that the autocratic behavior of scientific managers should be mellowed by taking industrial welfare and industrial relations policies into account, mitigating the Taylorites reliance on what materialized to workers as counter productive driving methods to increase production.The aftermath of war saw greater cooperation between former enemies and an apparent alignment of the

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Gilbreths' scientific management competition in their wake. But the Gilbreths did not trim down their energies in carving out their own path.Frank Gilbreth organized a 8 Committee for the Elimination of Unnecessary Fatigue within the Society of Industrial Engineers, holding regular fatigue luncheons at their quarterly meetings as a means of pushing motion study in its "human element" format to a ready audience of engineers and managers. He also efforts with the National Safety Council, the American Posture League, and the Eyesight Conservation Committee.At the same time, he arranged for a showdown between motion study and time study by preparing a lengthy indictment of stop-watch time study for presentation to the Taylor Society.Though the subsequent debate was as rancorous as it was inconclusive, and did nothing whatsoever to sway the stopwatch advocates to adopt Gilbreth's methods, it did at least afford the Gilbreths some personal satisfaction at seeing their enemies squirm.The future of motion study was by no means assured.To be certain, motion study, fatigue study, and the One Best Way were terms with a certain currency in engineering and management circles. But Gilbreth's continuing difficulties with actual factory installations led him to retain the veil of secrecy over his work, not surprisingly since eruptions of worker, manager, and owner dissatisfaction with his techniques were common.At the Auergesellschaft Company, for instance, workers associated with the powerful leftist Social Democratic Party at first watched Gilbreth's activities suspiciously as he renovated the company office system, then lucratively exacted of the directors that Gilbreth be prevented from extending his work to the shop floor.Only after the drafting of many workers into the armed forces with the outbreak of war was Gilbreth able to make any progress in their domain.In 1919 messenger boys at the Pierce-Arrow automobile company threatened to strike unless Gilbreth fulfilled his promises of promotion, which he took care of by disbanding the messenger system entirely.In 1924 workers at the American Radiator Company in Buffalo downed tools, refusing to be studied by Gilbreth's assistants, a condition which management resolved by revoking Gilbreth's contract and removing him from the plant. If anything,Gilbreth found foremen, superintendents, and managers more recalcitrant than workers. As he distorted their routines, usurped their prerogatives, and undermined their security with his systematic changes, they all too often reacted, as at Auergesellschaft in 1914-1915, Cluett-Peabody shirt company in 1916, U.S. Rubber Company in 1917, Pierce-Arrow in 1919, and American Radiator Company in 1923-24, by stalling, failing to respond to his directives, and questioning the quality of his work. Nor were owners always obliging, as Gilbreth's experiences at Herrmann-Aukam and American Radiator showed. In 1921 the owners of the Erie Forge Steel Company, financially straitened by the post-war depression,litigated against Gilbreth to get his expensive contract revoked, locking him out of the plant, and ultimately settling with him out of court. To darken the picture further, of the seventeen contracts Gilbreth gained between 1918 and 1924, he completed only five requiring limited work and three more involving only written recommendations. Of his six most important contracts requiring extensive factory renovation, five were cancelled prior to their completion.The Gilbreth's shifting tactics, their continual realignment of motion study technology and techniques in relation to their sense of the state of labormanagement relations, and their striving to build an identity unique among scientific managers manifest the ways in which they fashioned their product and themselves along political, sooner than sternly scientific-technological lines. Accordingly, their experiences argue well for the integration of micro-political analysis into scientific-technological history.Gilbreth was working on three contracts when his heart gave out in June 1924. At the instance of his death Gilbreth had entirely failed to prove the viability of motion study in industrial practice. Further, his continual attacks on stop-watch time study had done nothing to win members of the Taylor Society to his motion study banner.Known that he had not productively planned his individual cadre of admirers, the practical future of motion study, despite the soundness of its principles and techniques in theory and in literary reputation, remained in considerable doubt. Only Lillian Gilbreth's sterling efforts enabled her husband's brainchild to survive the 1920s. First, in a concise paper announcing that stop-watch time study, like motion study, had its place in scientific management, she capitulated to the obvious and declared a truce. Moreover, by running her own motion study schools and nurturing her husband's only installation assistant, Joe Piacitelli, she slowly

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laid the basis for motion study's continuation in practice.But it was not until the premature 1930's, when developments in camera and lighting technology made motion study less expensive and cumbersome, that Allan Mogensen and others led the regeneration of a declining art. The scope of the Gilbreths' efforts and travails illustrate the problems of gaining recognition and authority in a fluid business environment characterized by friction among competing parties. The production and marketing of a new product within a new management movement within a changing,contested industrial terrain pretensed special difficulties and necessitated bold tactics, especially as the Gilbreths were, essentially, small business people striving to retain financial independence in a milieu increasingly dedicated to economies of scale.

III. PLANT LAYOUT

The scope to which the layout of the factory or working area is important to the productivity of theprocess or activities undertaken varies greatly from industry to industry.Equally variable is the extent to which it is possible to alter the layout once it has been established.These two factors must be firmly in the minds of all work study men who have occasion to study the flow of materials or the of workers about the plant.Improving factory layout is part of the job of the work study man, but, since changes of layout usually mean moving plant, equipment and even pipes cables, he must work in close co-operation with the works manager and engineer. In many factories there has been no properly-thought-out change of since they were first opened. Benches, machines, pieces of plant and even whole departments have been added from time to time wherever space could be found.The result is that material often has to make long and roundabout journeys in the course of being processed.A great deal of time can be added to the total work content of a process bad layout, which causes unnecessary movement of material and uses up the time and energy of the workers without adding anything to the completion of the job. Plant layout is the production of a floor plan for organizing the desired machinery and equipment of a plant, established or contemplated,in the way which will permit the easiest flow of materials, at the lowest cost and with the minimum of handling, in processing the product from the receipt of raw material to the dispatch of the finished product.It is sometimes enviable to know about the paths of movement of men and materials through the factory or working area during the process of production or in the course of other activities.As a flow process chart alone will not give this information, it is useful to supplement it with other forms of recording, particularly the diagrams developed to indicate movement.Notable among these is the diagram.This is a diagram, substantially to scale, of the area covered by the process or activity, on which the location of the various points of activity and the paths of movement between them are shown.Before departuring to discuss in detail the flow diagram and its use, however, let us consider briefly some aspects of plant layout in different industries.

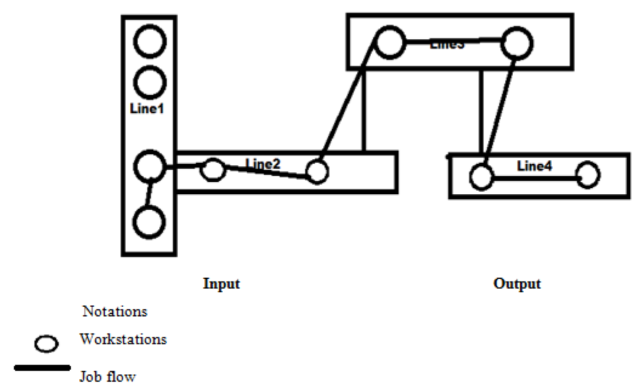

Fig1.Plant layout

In process layout,it is the sequence of manufacturing is flexible.Machines can be kept busy most of the time.Machine breakdowns do not hold up a succession of operations; work can be transfôrred to other similar machines nearby.Production volumes less than the rated or intended volume of output are probably less costly to produce with the process type of layout.When varied products are required in low and medium quantities, the process layout will probably require less total investment in machines than a product layout would.But more floor space is usually taken up with a process layout.There are no fixed paths along which all work must flow. Consequently there is more handling of materials; a larger volume of work in progress, and a more complicated system of production control is needed than that for a product layout. The flow diagram is employed to supplement the flow process chart.It is a plan,

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substantially to scale, of the factory or shop, with the locations of machines, workplaces and working areas correctly depicted on it.As a result of observation in the shop the paths of movement of the materials, components or products are traced, sometimes using the process chart symbols to denote the activities carried out at the various stopping points.Once the general picture of a process has been established, it is possible to go into greater detail.The first stage is to construct a flow process chart.A flow process chart is a process chart embarks the series of the flow of a product or a procedure by recording all events under review using the appropriate process chart symbols.

Models are easier to handle than templates.The fact that heights are to scale as well as length and breadth of machines and other equipment is often of value, especially in the case of materials handling operations.When necessary, models of doorways, pipelines, overhead conveyors and even roof joists may be included in order to show clearances and any obstructions to shafting or to the movements of stacking trucks, motor vehicles or overhead travelling cranes. Models are more valuable for demonstration and teaching purposes.It may be said that the importance of attaining the best possible layout is directly proportional to the weight, size or immobility of the product.If the product is very heavy or difficult to handle, involving expensive equipment or a large amount of labour, it is most important that it should move as little as possible between operations.Conversely,if the product or its components are very small and light, so that hundreds, or even thousands,representing, perhaps, several days' supplies, can be carried at one time, layout is comparatively unimportant.If the product is made up of a very large number of parts, so that a great many people are likely to be employed in moving them from shop to shop, or between operations in the same shop, good layout becomes important.Mass production methods of manufacture make extensive use of high volume machinery, often operated automatically, so that relatively little labour is needed for the direct manufacturing processes.In consequence, a high proportion of the total factory labour force may be engaged in transporting the output,if the layout is not good.If the moving and handling time represents a large proportion of the total time of manufacture, any reduction in time of travel or handling of the product or its components will have a marked effect on the productivity of the factory, especially if the product, though possibly light, is bulky, so that only a few can be transported at a time. Conversely, if the process time is very long, as in certain machining operations in heavy engineering which may last for days, layout be comes less important.Remember that when the process time is shortened by speeding up operations or by introducing high performance machinery, the ratio between handling time and process time is affected: handling time becomes relatively longer. In many plants in the United States and in some in the United Kingdom machine tools are not permanently fixed, but moved around at intervals to form product lines as new products go into In the light industries such as clothing, radio assembly and paper-bag changing the layout of shops is a relatively simple matter.Where changes in involve any considerable work, however, the management and the works will have to be convinced that real savings will be achieved before they will prepared to sanction them.The layout of manufacturing processes often depends to a great extent on tech nical considerations. Sometimes it can only be altered when a new plant is built.Examples of this are many chemical processes, such as fertiliser manufacture chemicals and the manufacture of synthetic fibres.In some industries this is very heavy and may be impossible to move once it has been set in place.Drop hammers and heavy presses are examples. It is usually difficult and to move textile machinery .On the other hand, most of the machines used in medium engineeringlathes, drills, milling machines and the likecan be without too much trouble and expense.People who have not been trained to read drawings find it much easier to see what a change will mean from a three-dimensional model than from an ordinary diagram.Models are most valuable for teaching the principles of layout and the handling of materials, as much as anything because everyone likes models; they are such fun to play with.People learn best when they are interested. The standard sequence of record and examine critically must be with the flow process chart when supplemented with a flow diagram.Once has been done and wasted time and effort abolished as far as feasible, it will be possible to develop the new layout.This will necessitate moving the points at which operations, inspections and storages take place around until the best that most economical of distance and time has been discovered. It is impossible to do this with the actual equipment, except in the case of the lightest. But it may be done mainly expediently on the flow diagram itself. The simplest methodand one which avoids covering the flow diagram and erasuresis to cut out pieces of cardboard the size (to scale) of the machines, benches and other pieces of equipment which it may be move in order to achieve the final layout. A scale ,4 in. = 1 ft or 2 cm = 1 m is convenient. These card pieces are known as "templates".Do not forget to templates for trucks and trolleys used in moving material around the working it may be necessary, when positioning machines or storage equipment, to make that gangways are wide enough for them to pass through or turn in.In templates and scale plans make sure that the dimensions of all equipment correct at the scale being used or, if anything, a little oversize; much time effort may go for nothing if templates are cut out slightly on the small side the space available in gangways and openings is overestimated in it.It is better to be on the safe side. Differently coloured cards may be used different types of equipment such as machines, storage racks, benches or equipment.It is important to mark in doorways, pillars and other obstructions. When trying out different arrangements templates can be held in place with ordinary pins or drawing pins; the former are easier to use if the templates going to be moved about a lot.Thread may be used to indicate paths of it is not wished to mark the diagram until the layout has finally been decided.Templates are being increasingly replaced by scale models of machines equipment for purposes of examining existing layouts and developing improved ones.These are especially valuable when planning new shops or factories.They have the following advantages over the ordinary two dimensional diagram.Models of machines and equipment need not be expensive, or elaborate, provided that they are made accurately to scale.The same warning as applies to templates applies to models.They can be made of wood and shaped roughly to the likeness of the equipment they represent as long as care is taken to ensure that the over-all dimensions are correct.Stacks of material, bar stock and material handling equipment of all kinds can be represented.A colour for different kinds of equipment can be used, e.g. green for production plant, yellow for material handling equipment, red for storage racks, and so on, the models being painted accordingly for ease of identification.Alternatively they may be painted the similar colours as the definite items of equipment.If the sheet representing the shop is stuck on to a thin steel sheet and small magnets are let into the models underneath, they will be very easy to move about and at the same time adherent enough to the sheet for the latter to be set vertically against a wall if desired.Coloured threads may be employed to represent paths of movement of various products or components in the same way as with the ordinary flow diagram.Although simple wooden models serve quite well enough for the solution practical layout problems, it is nowadays possible to obtain correct-to-scale reproductions of most common machine tools and many other items of industrial equipment.These beautifully made models are a delight to handle, and of course they look exactly like the machines they represent,which wooden models cannot always do. They are, however, costly.

The study of handling problems should be carried out along orthodox method study lines, using outline and flow process charts and flow diagrams so as to make certain that the layout of the working area is as good as it can be,taking account of all the situations, and that movement in any plane, horizontal or vertical, is reduced to a minimum.This is especially important when the purchase of handling equipment is mooted, since a change in layout will often alter not only the quantity but also the type of equipment necessary.Therefore the best sort of handling is no handling. The first step in tackling a handling problem is the same step used in all method study, namely to ask: "What is done?" and if the answer is "Handling", to ask: "Why is this handling done?" with a view to trying to eliminate all handling that cannot be shown to be unavoidable. Handling adds to the cost of production but adds nothing to the value of the product.So much emphasis has been placed on it, sometimes as a result of by producers of handling equipment, who are naturally anxious to increase their sales, that it was sometimes thought of as a new technique, which it is Method study has always been concerned with the managing of materials, and the principles involved are only those of motion economy, originally developed for the worker at his workplace,

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applied to the working area as a whole.Material handling is consequently a part of method study and cannot be alienated from it.To attempt to deal with it separately is likely to be expensive, since equipment may be purchased which may prove useless after method study has applied to the task for which it has been bought.If method study had been applied before the trucks had been purchased a heavy outlay of money would have been and the money saved could have been used more productively elsewhere.A great pact of exposure was agreed in the decade after the Second World War to the managing of materials, especially in Europe.This was one result of the visits of many teams concerned with productivity to the United States.The subject in fact extremely important, since handling may take up as much as 85 per cent of the total process time.There are certain precepts which it is constructive to stand in mind when tackling handling problems.Always try to keep materials at the height at which they are to be worked upon.Wherever anything is picked up or put down there is a leeway of cutback handling.Never put materials on the floor, where this can be avoided.Use a pallet or platform. (There is an additional cause for this: in a busy shop work put on the floor tends to stay on the floor and very soon accumulates instead of moving through the processes to completion). Always keep distances over which material is handled as short as possible.(This will happen automatically if proper method study procedures are carried out).Let gravity work for you.Gravity costs countless money in industry; it may as well be used whenever possible.Let material roll or slide down chutes to the next work station whenever possible, instead of pushing it or carrying it.Always handle in bulk over distances, e.g. wait until there is a barrow load of castings before moving them instead of having a labourer carry each one separately Always have sufficient boxes, platforms or containers available at the workplace (at least two), so that the operative can remove the piece he is to work on from one container; place it in another when he has finished his work.When the second one is full it is moved to the next operation, while the first one, now empty, takes its place.This practice can be very well with wheel barrows.Do not try to reduce the number of labourers fetching and carrying unless this can be done without adding to the handling done by operators.This is an important rule, since it governs the application of the previous ones.The only exception is when the operators can do the work while necessarily unoccupied during a machine- or process-controlled cycle. Keep gangways clear. It is no use investing in expensive equipment if it is going to be held up by obstructions.The directly productive or skilled operator should be relieved of which hinder him from giving all his time to his producfive work.It may even increase the productivity of an undertaking as a whole if labour is specially in order to relieve productive workers of tasks such as fetching and carrying their own materials.

Power-driven conveyors may appear to be the ideal solution to both assembly and transport. Method study, however, can often find cheaper hiore effective means of solving them,by rearranging layouts and modifying processes.Conveyors, in their many forms, are most valuable pieces of equipment properly used.Putting a process on to a conveyor calls for careful study planning.All over the world conveyors are lying discarded in corners of factories. A special caution: do not be led into installing power-driven conveyorswithout very careful study, espec ially if there is any thought of using them for assembly work.The range of equipment available for the handling of materials is far too wide.In large firms it is common to have a specialist material handling equipment who is able to advise departments, including work study department, on the most suitable equipment for any given In smaller firms with a limited range of activities this is not necessary.The different types. of equipment needed in an undertaking confining its to a small number of products. is. not large, and it is the business of the work man to make himself familiar with all the equipment likely to be useful in the type of bus.iness in which he is working.Manufacturers of handling equipment usually glad to arrange demonstrations of their products, but the work study man, while taking advantage of these to see new types, should know enough not to be persuaded into buying unsuitable equipment and, perhaps more important, to allow his manager to be persuaded.

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IV .MOTION STUDY

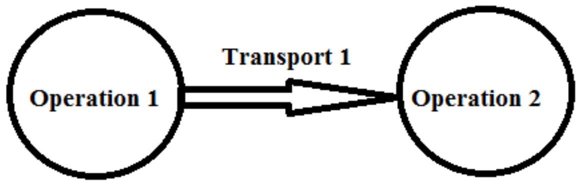

Fig.2 Motion Study

There are various kinds of action in which workers move at irregular intervals between a number of points in the working area, with or without material.This situation occurs very often in industry and commerce and even in the home.In manufacturing shops it occurs when bulk material is being fed to or removed from a continuous process, and is stored around the process; an operative is looking after two or more machines; labourers are delivering materials to or removing work from a series of machines or workplaces.Outside manufacturing operations, examples of its occurrence are in stores and shops where a variety of materials are being from or put away into racks or bins; in restaurant and canteen kitchens during the preparation of meals,in control laboratories where routine tests are carried out at intervals.

The work study man proceeds to follow the worker in whom he is interested as he moves from point to point in doing his job.(If the working area is a small one and he can see the whole of it from one point he can watch the worker without moving.The studyman notes methodically each point to which the worker moves and, if the journeys are fairly long,the times of arrival and departure.It will save a good deal of writing if the observer codes the various machines, stores and other points of call by numbers, letters or other means.A string diagram can be used to plot the movements of materials, and this is sometimes done, especially when it is required to find out easily just how far the materials travel.The simple flow showed all that was needed, and was quicker to prepare for the illustrated.The string diagram is most often used, however, for plotting the movements of workers.This recording will continue for as long as the work study man thinks necessary to obtain a representative picture of the worker's movements, which may be a few hours, a day, or even longer.The studyman must be sure that he has got all journeys made by the worker and has seen them made enough times to be sure of their relative frequency.Insufficient study may produce a misleading picture, since the work study man may only have watched the worker during a part of the complete cycle of activities when he was using only a few of his various paths of movement.Later in the cycle he may not use these at all but use others a great. Once the studyman is satisfied that he has a true picture which should be checked with the worker concerned to make sure that there is nothing else which is usually done that has not been observedthe string diagram may be constructed.A scale plan of the working area similar to that required for a flow must be made (the same plan may be used so long as it has been accurately Machines, benches, stores and all points at which calls are made should be drawn in to scale, together with such doorways, pillars and partitions as are likely affect paths of movements.The completed plan should be attached to a or composition board, and pins driven into it firmly at every stopping point, heads being allowed to stand well clear of the surface (by about 1 cm). Pins also be driven in at all the turning points on the route.

A man type flow process chart is a flow process chart which records what the worker does.The definition of the man type chart given above states that it records the worker does.The definitions of the other two flow process charts, state that they record (material type) what happens to material, and type) how the equipment is used. The definitions thus reflect the charting which is to use mainly the active voice on man type charts, and mainly the voice on the other two.The convention, which has been followed on all the flow.The charting procedure used in compiling a man type flow process chart almost exactly the same as that used on material type flow process charts.There is one slight difference however, a useful charting convention which helps to distinguish man type charts from the other two flow process charts, and will be found quite natural in practice.The same techniques which have been used to follow materials through operations and movements which they undergo can be used to record the movements of a man Man type flow process charts are frequently used in the jobs which

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are not highly repetitive or standardised.Service and work, laboratory procedure and much of the work of supervisors and can be recorded on charts of this type.Since the charts follow one individual or a group performing the same activities in sequence, the standard flow process forms can be used.It is usually essential to attach to the man type flow chart a sketch showing the path of movement of the worker while carrying out the operation charted.

S.No.	Process
1.	Cutting
2.	Transportation
3.	Milling
4.	Transportation
5.	Juice storage tank
6.	Transportation
7.	Mixing Chamber
8.	Transportation
9.	Heaters
10.	Transportation
11.	Crystalizers
12.	Transportation
13.	Sugar production chamabers
14.	Storage

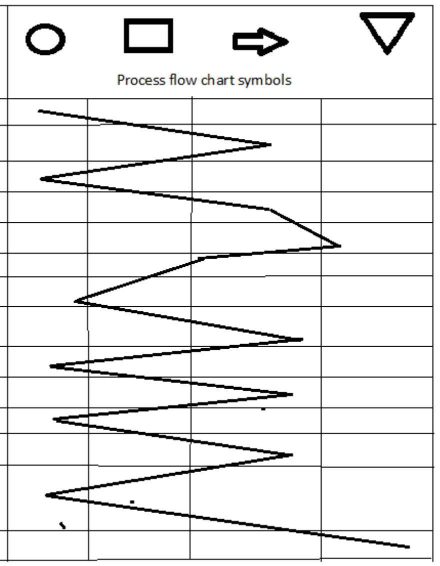

Fig.3 Process flow chart

We come now to the first of the charts which use a time scale the multiple activity process chart. This is used when it is necessary to record on one chart the activities of one subject in relation to another.The multiple activity chart is extremely useful in organising teams of operatives on mass-production work; also on maintenance work when expensive plant cannot be allowed to remain idle longer than is absolutely necessary.It can be used to determine the number of machines which an operator or should be able to look after.By using separate vertical columns, or bars to represent the activities of different operators or machines against a general time scale the chart confirms very clearly periods of idleness on the part of any of the subjects,during the process. A study of the chart often makes it possible to rearrange these activities so that such ineffective time is reduced.A multiple activity chart is a chart on which the activities of more than one subject (worker, machine or equipment) are each recorded on a common time scale to show their interrelationship.The multiple activity chart can also be used to present a picture of the operations performed simultaneously by a man and one or more machines.In this way the beginning and end and hence the duration, of every period of activity of either man or machine are clearly seen in relation to one another.By a study of these activities it is possible to determine whether better use can be made of the operator's time or of the machine time.In particular, it offers a means of determining whether a man minding a machine, whose time is only partly occupied, can manage to service another machine, or whether the increase in ineffective time of the two machines will offset any gain to be obtained from employing the man's time more fully. This is an significant query in those countries where manpower is more willingly obtainable than machines and other capital equipment.

When the movement patterns are complex, the travel chart is a quicker and more manageable recording technique to use.The travel chart is always a square, having within it smaller squares small square represents a work station.A travel chart is a tabular record for presenting quantitative data about the movements of workers, materials or equipment between any number of places over any given period of time.

In considering the movements of men and materials on the larger scale have been concerned with the better utilisation of existing plant through the elimination of unnecessary idle the more effective operation of processes and the better utilisation of the of labour through the elimination of unnecessary and time-consuming movement within the working area of factory, department or yard.The time has now come to look at one man working at a workplace,or table and to apply to him the principles which have been laid down and procedures shown in the examples given.we have examined procedures of a general nature for improving the effectiveness with which complete sequences of operations are performed and with which material flows through the working area.Turning from material to men, we have discussed methods of studying the movements of men around the working area and the relationships between men and machines or of men working together in groups.We have done so following the principle that the broad method of operation must be put right before attempting improvements in detail.As our example of the Egyptian trolleymen's need for relaxation

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shows, factor of fatigue affects the solution of problems even when dealing with larger than the individual workplace.But when we come to study the operator at the workplace, the way in which he applies his effort and the amount of resulting from his manner of working become primary factors in affecting productivity.Before embarking on a detailed study of an operator doing a job at a workplace it is important to make certain that the job is in fact necessary being done as it should be done.The questioning technique must be applied as to purpose to ensure that the job is necessary;place to ensure that it is being done where it should be done;sequence to ensure that it is in its right place in the sequence of operations;person to ensure that it is being done by the right person.Once these have been verified and it is certain that the job cannot be or combined with another operation it is possible to go on to determine the means by which the job is being done and to simplify them as much as is economically justified.Consider the recording techniques adopted to set out the detailed movements of an operator at his workplace in ways which facilitate critical examination and the development of improved methods, in particular the two-handed process chart.Before doing this, however, it is appropriate to discuss the principles of motion economy and a number of other matters which influence the design of the workplace itself, so as to make it as convenient as possible for the worker to perform his task.

Priciples of motion economy are useful in shop and office alike and, although they cannot always be applied, they do form a very good basis for improving the efficiency and reducing the fatigue of manual work. The ideas expounded by Professor Barnes are described here in a somewhat simplified fashion.There are a number of "principles" concerning the economy of movements which have been developed as a result of experience and which form a good basis for the development of improved methods at the workplace.They were first used by Frank Gilbreth, the founder of motion study, and have been amplified by other workers, notably Professor Barnes. They may be grouped under three headings utilize the human body, pacts of the workplace, design of tools and equipment. Utilize the human body, when possible,the two hands should instigate and inclusive their movements at the same time, The two hands should not be idle at the same time except during periods of rest,Motions of the arms should be symmetrical and in opposite directions and should be made simultaneously,Hand and body motions should be made at the lowest classification at which it is possible to do the work satisfactorily,Work should be arranged so that eye movements are confined comfortable area, without the need for frequent changes of focus, Rhythm is essential to the smooth and automatic performance a repetitive operation.The work should be arranged to permit easy, and natural rhythm whenever possible,"Ballistic" (i.e. free-swinging) movements are faster, easier and accurate than restricted or controlled movements,Continuous curved movements are to be preferred to motions involving sudden and sharp changes in direction.Momentum should be employed to help the worker, but should reduced to a minimum whenever it has to be overcome by muscular effort.In arrangement of the workplace,The colour of the workplace should contrast with that of the and thus reduce eye fatigue.Provision should be made for adequate lighting, and a chair of type and height to permit good posture should be provided.Height of the workplace and seat should be arranged to allow standing and sitting.“Drop deliveries" or ejectors should be used wherever possible that the operator does not have to use his hands to dispose of finished work,Materials and tools should be arranged to permit the best of motions.Tools, materials and controls should be located within the working area and as near to the worker as possible,Gravity feed, bins and containers should be used to deliver the materials as close to the point of use as possible,tools and materials should be pre-positioned to reduce searching,Definite and fixed stations should be provided for all tools and materials to permit habit formation.In design of tools and equipment,two or more tools should be combined wherever possible,the hands should be relieved of all work of "holding" the workpiece,where this can be done by a jig, fixture or foot-operated device, Handles such as those on cranks and large screwdrivers should be intended so as to consent as much of the surface of the hand as possible to come into contact with the handle. This is especially when considerable force has to be used on the handle,Where each finger performs some specific movement, as in type writing, the load should be distributed in accordance with the inherent capacities of the fingers,Levers,crossbars and handwheels should be so placed

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that the operator can use them with the least change in body position and greatest "mechanical advantage".The Gilbreths pioneered the study of manual motions and developed basic laws of motion economy that are still relevant today.They were also responsible for the development of detailed motion picture studies, termed as Micro Motion Studies, which are enormously useful for analyzing highly repetitive manual operations. With the improvement in technology, job simplification so that it is less fatiguing and less time consuming.While motion study involves a simple visual analysis, micro motion study uses more expensive equipment.The two kinds of revised may be contrasted to viewing a task under a magnifying glass versus viewing the same under a microscope.The added detail revealed by the microscope may be necessitated in exceptional cases when even a minute improvement in motions matters, i.e. on extremely short repetitive tasks.Traditionally,the data from micro motion studies are recorded on a Simultaneous Motion (simo) Chart while that from motion studies are recorded on a Right Hand - Left Hand Process Chart.On analysing the result of several motion studies conducted, Gilbreths concluded that any work can be done by using a combination of some or all of seventeen basic motions, called therbligs.These can be classified as useful therbligs and ineffective therbligs.Effective therbligs take the work progress towards completion. Attempts can be made to shorten them but they cannot be eliminated.Ineffective therbligs do not advance the progress of work and therefore attempts should be made to eliminate them by applying the principles of motion economy.It is a graphic representation of an activity and shows the sequence of the therbligs or group of therbligs performed by body members of operator. It is drawn on a common time scale.In other words, it is a two-hand process chart drawn in terms of therbligs and with a time scale.Making the Simo Chart. A video film or a motion picture film is attempted of the operation as it is carried out by the operator.The film is analyzed frame by frame. For the left hand, the sequence of therbligs (or group of therbligs) with their time values are recorded on the column corresponding to the left hand. The symbols are inserted against the length of column representing the duration of the group of therbligs.The procedure is repeated for the right hand and other body members (if any) involved in carrying out the operation.It is generally not possible to time individual therbligs.A certain number of therbligs may be grouped into an element large enough to be measured as can be see .From the analysis shown about the motions of the two hands (or other body members) involved in doing an operation, inefficient motion pattern can be identified and any violation of the principle of motion economy can be easily noticed. The chart, therefore, facilitates in improving the method of doing an operation so that balanced two-handed actions with coordinated foot and eye motions can be achieved and ineffective motions can be either reduced or eliminated.The result is a smoother, more rhythmic work cycle that keeps both delays and operator fatigue to the minimum extent.The two-handed process chart can be concerned to a huge array of assembly, machining and clerical jobs. In assembly operations tight fits and awkward positioning present certain problems.In the assembly of small parts with close"positioning before assembly" may be the longest element in the cycle. In cases "positioning" should be shown as a separate movement ("Operation") from the actual movement of assembly (e.g. fitting a screwdriver in the head of a small screw). This enables attention to be focused on it and, if it is shown against a time scale, its relative importance can be assessed.Major savings can be made if the number of such positionings can be reduced, as for example by slightly countersinking the mouth of a hole and putting a chamfer on the end of the shaft fitting in it, or by using a screwdriver with a self-centring bit.The very act of making the chart enables the work study man to gain an intimate knowledge of the details of the job, and the chart itself enables him study each element of the job by itself and in its relation to other elements.From this study ideas for improvements are developed.These ideas should be down in chart form when they occur, just as in all other process charting. It may be that different ways of simplifying the work can be found; if they are all charted they can be compared easily. The best method is generally that which requires fewest movements.The two-handed process chart is generally used for repetitive operations,when one complete cycle of the work will be recorded. Recording is carried out in more aspects than is usually employed on flow process charts.What may be shown as a single operation on a flow process chart may be broken down into a number of elemental activities which together make up the operation.The two-handed process chart usually employs the same symbols as the other process charts.The simo chart is the micromotion form of the man type flow process chart.Because simo charts are used primarily for operations of short duration,performed with extreme rapidity, it is generally necessary to compile them from films made of the operation which can be stopped at any point or projected in motion. It will be seen that the movements are recorded against time measured in "winks" (1 wink = 1/2000 minute).These are recorded by a "wink counter" placed in such a position that it can be rotating during the filming.Motions are classified for each hand. A simo chart is a chart, often based on film analysis, used to record simultaneously on a common timescale the therbligs or groups of therbligs performed by different parts of the body of one or more workers.

V. CONCLUSION

After realizing the recommended enhancement ideas, It will advance the contemporary process by sinking the number of workstations,transportations,mingling the operations and tumbling the worker’s fatigue.From the above symposium it can de concluded that the process can be enhanced based on method study, work procedure and proper deployment of workers.

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