

Ergonomics Risk Assessment of Workers In Apparel Industry

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Abstract: Apparel industry is typically regarded as a safer place to work, while compared to other industries. The major health risk in this industry does not arise immediately, potentially fatal hazards. Instead the risks of apparel workers face come from more subtle hazards whose effects accumulate overtime. Cutting/sewing/Finishing/packing workers face substantially higher risks of muscle pain, body pain, injury on joints etc than workers in other task. Finally this causes WMSD (Work related musculoskeletal disorders) and occupational health issues. Therefore these study was undertaken to evaluate the various task performed by workers in the Cutting / sewing / Finishing / packing department and work postures adopted by them. Bases on scientific observation methods REBA (Rapid entire body assessment) we can determine the workers unsafe postures analysis and recommending the ergonomics changes in the workplace with effectively. Directly it will help to improve of workers health, wellbeing and workplace ethics and indirectly enhances the productivity.

Keywords: Apparel industries, Ergonomics risk assessment, WMSD, REBA assessment tool, Occupational hazards

I. INTRODUCTION

The textile and clothing industry in India is strong throughout the value chain, from fiber to yarn to fabric to clothing. A number of safety and health issues affect the garment industry. In India, the majority of units involved in textile-related operations have ergonomic problems, hazardous and unhealthy working environment. Workers in these facilities encounter a variety of issues, including inappropriate furniture, difficult postures, inadequate ventilation and illumination, and a lack of effective emergency safety measures.

Workers in these units are susceptible to a variety of occupational illnesses. Carpal tunnel syndrome, forearm tendinitis, bicapital tendinitis, lower back discomfort, epicondylitis, neck pain, shoulder pain, and osteoarthritis of the knees are only a few of the musculoskeletal illnesses that have been reported among employees due to poor ergonomic circumstances. These problems are more prevalent in developing countries than in developed ones.

(Meral Isler et al., 2018) “Ergonomic Assessment Of Working Postures In Clothing Sector With Scientific Observation Methods” From his research, I understand that employees in the clothing industry are examined in three different ways in order to determine working postures, identify stress factors in the musculoskeletal system, and determine exposures based on working postures. REBA (Hignett and McAtamney, 2000), Ovako Working Posture Analyzing System (OWAS) (Karhu et al., 1977), and PLIBEL (Kemmlert, 1995) are scientific observation-based methods used in the study.

(P Yasotha et al., 2018) [3] “Ergonomic Evaluation of Work Place in Apparel Industry” from her study I can understand the assessment of work posture of workers engaged in different activities of apparel industry. Because of a lack of ergonomics awareness, the majority of workers have awkward postures. As a result, the workers are at moderate to high risk of developing musculoskeletal disorders. The goal of this research is to look at conditions in the clothing industry to determine how these injuries occur and how they can be avoided.

(Sue Hignett et al.,1999)“Rapid Entire Body Assessment (REBA)” from this technical note we can get the details of the preliminary stage in the development of a postural analysis tool, Rapid Entire Body Assessment (REBA). REBA has been developed to fill a perceived need for a practitioner's field tool, designed to be sensitive to the type of unpredictably changing working postures common in the health-care and other service industries. Over 600 postural examples were collected and individually coded by a team of ergonomists, physiotherapists, occupational therapists, and nurses to create a new tool that incorporates dynamic and static postural loading factors, human-load interface (coupling), and a new concept of a gravity-assisted upper limb position.

(Manuel Hita-Gutiérrez Et Al., 2020) [3] “An Overview of REBA Method Applications in the World” The purpose of this study is to examine literature from across the world in which the Rapid Entire Body Assessment (REBA) ergonomic assessment method has been used, and to tally the number of times REBA has been used in conjunction with other methods and the resulting incidence. In terms of knowledge, country, year, and journal sectors, the REBA approach is used.

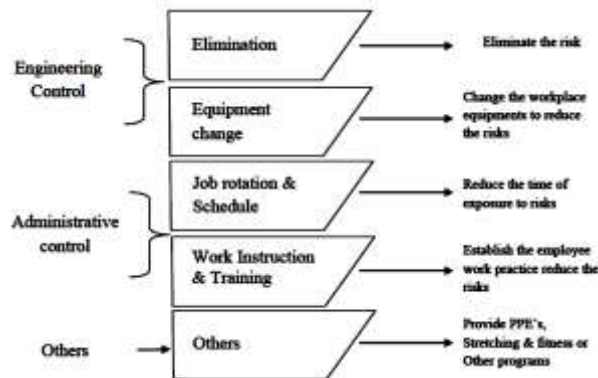
II. ERGONOMICS RISK ASSESSMENT

Ergonomic risk assessment is a component of the risk management process, which will include a systematic analysis of potential hazards to health and accidents. The goal of an ergonomic risk assessment is to eliminate work-related health risks by identifying existing or potential hazards that could lead to WMSDs. Once risk factors have been identified, interventions to reduce or minimize them must be implemented. Risk assessments can also be used to assess the effectiveness of a workplace intervention.

A. Objectives of ergonomics risk assessment

The primary goal of ergonomic risk assessment is to identify risk factors in the workplace that may lead to musculoskeletal disorders or injuries among workers. The goal of an ergonomic assessment is to identify and quantify these risk factors so that we can make measurable improvements in the workplace. A thorough ergonomic assessment is the foundation for making the workplace safer, healthier, and less injury-prone, as well as improving overall workplace wellness.

We could implement control measures to reduce injury and increase workplace comfort after conducting an ergonomic assessment.



Standing desks, adjustable chairs and workstations, footrests, anti-fatigue standing mats, occupational therapy, and training to improve neck and shoulder posture are all possible workplace modifications.

B. WMSD (Work Related Musculoskeletal Disorders)

Musculoskeletal disorders, also known as MSDs, are cumulative and chronic soft tissue injuries that affect muscles, tendons, ligaments, nerves, joints, and blood vessels. When abused or misused, the body has limits and can fail or wear out. MSDs are defined as injuries to muscles, tendons, ligaments, joints, nerves, and discs caused or exacerbated by our actions and/or an environment that does not adhere to healthy and safe working practices. A well-known MSD is carpal tunnel syndrome which occurs when the nerve, which runs from the forearm into the palm of the hand, becomes pressed or squeezed at the wrist. The carpal tunnel - a narrow, rigid passageway of ligament and bones at the base of the hand - houses the 5 median nerve and tendons. Sometimes, thickening from irritated tendons or other swelling narrows the tunnel and causes the median nerve to be compressed resulting in pain, weakness, loss of grip or numbness in the hand and wrist, radiating up the arm. WMSDs may progress in stages from mild to severe.

Early stage: Aching and tiredness of the affected limb occur during the work shift but disappear at night and during days off work. No reduction of work performance.

Intermediate stage: Aching and tiredness occur early in the work shift and persist at night. Reduced ability to perform repetitive tasks.

Late stage: Aching, fatigue, and weakness persist at rest. Inability to sleep and perform minor tasks.

Not everyone goes through these stages in the same way. In fact, it may be difficult to say exactly when one stage ends and the next begins. The first pain is a signal that the muscles and tendons should rest and recover. Otherwise, an injury can become longstanding, and sometimes, irreversible. The earlier people recognize symptoms, the quicker they should respond to them.

The table below outlines occupational risk factors and symptoms of the most common disorders of the upper body associated with WMSDs.

DISORDERS	OCCUPATIONAL RISK FACTORS	SYMPTOMS
Tendonitis/tenosynovitis	Repetitive wrist motions Repetitive shoulder motions Sustained hyper-extension of arms. Prolonged load on shoulders	Pain, weakness, swelling, burning sensation or dull ache over affected area
Epicoudylitis (elbow tendonitis)	Repeated or forceful rotation of the forearm and bending of the wrist at the same time	Same symptoms as tendonitis
Carpal tunnel syndrome	Repetitive wrist motions	Pain, numbness, tingling, burning sensations, wasting of muscles at base of thumb, dry palm
DeQuervain's disease	Repetitive hand twisting and forceful gripping	Pain at the base of thumb
Thoracic outlet syndrome	Prolonged shoulder flexion Extending arms above shoulder height Carrying loads on the shoulder	Pain, numbness, swelling of the hands
Tension neck syndrome	Prolonged restricted posture	pain

III. PROBLEM OF STATEMENT

Typically, in the workplace, a worker is forced to work within the confines of an existing job or workstation. Employees may be required to work in awkward postures, repetitive movements; strained postures perform the same motion repeatedly. All of these factors may contribute to work-related musculoskeletal disorders.

A. *Workplace fatigue*

Workplace fatigue is defined as a person's reduced ability to perform their job effectively. This could be due to both physical and mental exhaustion. These symptoms can develop over time and, if not addressed, can be detrimental to overall well-being and productivity.

The symptoms of fatigue can include:

- Extreme tiredness (there could be other reasons why you could be feeling tired)
- Feeling sleepy
- Muscle pain
- Struggling to concentrate
- Feeling dizzy
- Low mood
- Blurred vision
- Headaches
- Poor judgement

Workplace fatigue can have a negative impact on safety and productivity. Fatigue symptoms can contribute to more accidents and injuries. MSDs can be long-term consequences of workplace fatigue. Work-related MSDs are frequently associated with jobs that require workers to stand for the majority of the day. They are typically defined as issues that can affect the upper limbs, back, and lower limbs. These signs can often indicate if an employee is suffering from fatigue:

- Visible signs of pain or discomfort while standing or sitting
- Absenteeism
- Regular yawning
- Looking drowsy
- Changes in working behavior
- Lower productivity
- Struggle to concentrate
- Reduced level of good judgement
- Slower reflexes

B. *Illness And Injuries Among Textile Workers*

- 70% of sewing machine operators using foot controls report back pain
- 35% report persistent lower back pain
- 25% have suffered a compensable cumulative trauma disorder (CTD)
- 81% reported CTDs to the wrist
- 14% reported CTDs to the elbow
- 5% reported CTDs to the shoulder
- 49% of workers experience neck pains
- Absenteeism increases as working conditions worsens
- Loss of worker force due to injuries or high turnover is associated with working conditions
- Hand sewing and trimming are stressful to upper limbs
- Stitching tasks are associated with pain in the shoulders, wrists, and hands
- Ironing by hand is associated with elbow pain
- Garment assembly tasks are associated with CTDs of the hands and wrists
- Foot operated sewing is associated with pain in the back

C. *General Ergonomic Risk Factors*

The following are factors for developing an MSD.

- Force
- Heaving lifting
- Push or pull
- Carrying
- Gripping
- Awkward or prolonged postures
- Repetitive activities
- Overhead work
- Contact stress
- Vibration

IV. METHODOLOGY

A well-designed assessment tool's goal is to take information gained from research on the causes and effects of strain on the human system and organize questions, calculations, or data to help visualize and predict when this strain reaches levels that could lead to work-related musculoskeletal disorders.

A. REBA (Rapid Entire Body Assessment)

The Rapid Entire Body Assessment (REBA) method was developed by Dr. Sue Hignett and Dr. Lynn McAtamney, ergonomists from University of Nottingham in England (Dr. McAtamney is now at Telstra, Australia). REBA is a postural targeting method for estimating the risks of work-related entire body disorders. A REBA assessment gives a quick and systematic assessment of the complete body postural risks to a worker.

The Rapid Entire Body Assessment (REBA) is a tool for assessing the risk of musculoskeletal disorders (MSDs) associated with specific job tasks. It is a whole-body screening tool that assesses biomechanical and postural loading on the body using a systematic procedure. The advantages of this tool are that it is simple, quick, and requires little equipment (pen and paper), allowing you to complete multiple assessments per task or job. The REBA evaluates the entire body and can be used to evaluate any task.

B. Importance & Advantages Of REBA Method

REBA has the advantage of evaluating various body parts, including the upper limbs (arm, forearm, and wrist), lower extremities, trunk, and neck. It is a useful method for identifying workers' forced postures and, if necessary, developing improvement measures. It is concluded that the use of the REBA method has increased over the last decade, most likely due to the digitization of knowledge. It is almost always used in conjunction with other methods, and its use can be a good indicator of a company's long-term viability.

The main advantages of the REBA method are

- The cost-effectiveness ratio is good.
- It is easy to apply. Pen and paper are enough for data collection; however, there are computer applications that speed up/facilitate its use.
- The most conflictive ergonomic aspects are identified from the individual score obtained after assessing each part of the body

C. REBA Assessment process steps

Identify a job: We can identify a job to assess by reviewing work postures, strained postures, and repetitive tasks, as well as where previous injuries have occurred, operator complaints have been reported, or quality issues have been raised.

Understanding the Tasks Within The Job: Interview the operator to learn about the main job tasks, the task demands, and the operator's perception of the most difficult component(s) of the job. Identify the job-related tasks- Intuitively; they appear to be the most vulnerable to MSD.

Choose the "worst" parts of the task to evaluate based on personal observation and information gathered from the operator interview. This should be determined by the most awkward postures present, the most force exerted, awkward postures held for an extended period of time, or awkward postures repeated multiple times. Take a photograph of the "worst" moment

Complete the REBA data collection form: The REBA assesses the entire body, including the upper and lower arms, the wrist, the neck, the back, and the legs. Compare the position or postures of each body segment in the photo to those outlined on the REBA data collection form. Based on these postures, the REBA assigns a score to each body segment. It should be noted that if the upper limbs are performing different actions, they must be analysed separately (right versus left upper limb).

Determine the REBA score: The REBA assigns a single final score based on the evaluated posture, force requirements, type of movement, frequency of movement, and coupling within the task. This single value, ranging from 1 to 15, represents the operator's work-related MSD risk. It also adds a sense of urgency to workstation engineering changes. A score of 8 or higher indicates that the workers completing the task are at high risk of MSD and that engineering controls are recommended.

Continue the job improvement process: If we have a low- to very high-risk REBA score, we may need to develop solutions to reduce the worker's MSD risk. Check the work after the improvement(s) have been implemented. Complete another REBA data collection form; if our improvements were successful, our REBA score should be lower. This is a critical step because it allows the evaluator to check in with the operators (do they like the change or are they adapting to it) and ensures that the improvement did not introduce new MSD risk factors.

V. DATE COLLECTIONS

In this assessment we included the activities of Cutting section, sewing section, Finishing sections and packing. We take into the account of most awkward postures, Repetitive motions and strained work of the workers in daily work activity of the apparel industry. Photos of the different positions and step by step actions of the workers are recorded and REBA assessment will be done.

Workers' perceptions of their physical work conditions were solicited via a questionnaire, prepared from the OSHA (Occupational Safety and Health Administration), U.S. Department of Labor. The questionnaire was administered and assessed in the plant to a total of 30 workers, who are all working in the Cutting section, sewing section, finishing sections and packing.

A. Task Wise Postural Assessments



VI. CONTROL MEASURES & RECOMMENDATIONS PROPOSED

S.No	Department	REBA Final Risk Level	Control Measures					
			Engineering Control		Administrative		Others	
			Eliminate	Equipment Change	Job rotation & schedule	Work instructions & training	PPE's	Yoga and stretching
1.	Cutting Section	Medium, High risk	NP	P	P	P	P	P
2.	Sewing Section	Medium, High risk	NP	P	NP	P	NP	P
3.	Finishing Section	Medium, High risk, Very High risk	NP	P	P	P	P	P
4.	Packag Section	Medium, High risk, Very High risk	NP	P	P	P	P	P

NP: Not Possible P: Possible

Following an assessment of all sections of work and worker interviews, we proposed some recommendations to reduce the very high risk, high risk, and medium risk levels to a lower risk level. These are the

- Roller type stand to provide free movement and also avoid excessive force and exhaustions.
- Automatic end cutter with switch will reduce the hand and elbow over reaching
- To be provided partitions fixed tables, to reduce the extensive reach of the workers and ease of handling.
- A cutting table with an air blowing tabletop creates an air cushion on which the spread fabric floats, allowing it to be easily moved.
- To avoid excessive reach and shoulder twisting, team cutting should be encouraged.
- A height-adjustable table is provided to reduce extra force and facilitate handling.
- Padded scissors will be used to alleviate finger strain and make handling easier.
- Padded grip cordless electrical scissors will be used easily and light weight and ergonomically designed. The scissors should not weigh more than ½ kg and be less than 9 inches long in order to be manageable when cutting through a swath of fabric.
- To be provided to height adjustable and flexible lumbar support system, it can help reduce pain in the workers neck, shoulders, and back, making these labour-intensive and frequently time-consuming activities more comfortable.
- To be equipped with an arm rest pad in order to avoid excessive tiredness. Armrests don't only affect your back and arms, though. Using them also relieves the load on your neck and shoulders. That makes you feel more comfortable and active while working.
- The primary benefits of this feature consist of promoting a good posture and reducing the stress on your lower limbs and back
- Footrests help reduce back strain and allow a worker to change positions by shifting weight. Footrests align posture, reduce fatigue, and ease pain or discomfort in the feet, ankles, knees, and thighs. The user is less likely to stay in an entirely static position for long periods of time.
- Footrest with a massage surface also reduces the fatigue helps to improve blood circulation.
- Providing height adjustment based on the operator's height improves the working environment, decreases chronic difficulties, improves posture, and prevents muscular inactivity. Much more pleasant to work in. Greater comfort leads to greater satisfaction.
- The best layout plan and proper working aids are used to reduce the workers' excessive reach and hand and joint fatigue.
- An inclined surface reduces neck and head bending, as well as back pain. It also reduces overreach in the corner area.
- The use of a sit-stand stool relieves pressure on the joints and promotes proper blood flow back to the heart, preventing permanent damage to body tissues. Standing posture is primarily supported by the muscles of the legs and trunk.
- Sit-stand stools are height adjustable, making it simple to use all height groups.
- The automatic tape dispenser eliminates wrist operation, produces exact length, and reduces tape waste. The automatic tape dispenser eliminates the need to handle dangerous razors and scissors while manually cutting tape. The rate of production has been dramatically increased.
- Ergonomically designed tables and storage racks reduce back twisting, and the storage space allows for easier carton handling and a better working environment. Ease of use of space. It defines the locations of materials and accessories and makes height adjustment easier.
- Tilting box stand mainly reduces the trunk bending. It has a gas strut assist that keeps the tilt roller table at a 45-degree angle until you want to transfer your package from it to a conveyor or elsewhere
- This tilting roller table holds your boxes at an ergonomic angle for easy packaging, and then tilts down flat for transferring.
- Tables reduce the possibility of workers injuring themselves while repeatedly bending down and picking up stock from the ground to be stored.
- Workers can lift a box of stock once from the ground and place it at waist height on the raised scissor table, reducing the amount of bending required to pick up the stock for storage.
- Anti-fatigue mats help protect your workers and keep them feeling refreshed. Anti-fatigue mats are beneficial for more than just preventing long-term health issues.
- Promote good posture, Increase productivity, and Prevent joint stiffness, Reduce headaches, Lower back pain, and Reduce foot pressure.

- Job rotation is the structured interchange of workers between different jobs, requiring workers to rotate between different workstations or jobs at certain time intervals. It's important to remember that job rotation doesn't eliminate ergonomic risk factors. After taken detailed assessment and analysis must be started the job rotations.
- It will Reduced exposure to focused physical demands of one job, Reduced physiological stress, strain, and fatigue to muscle group used for one job, Reduces employee exposure to high-risk job demands, Reduced MSD incidents and severity, Increased innovation and improved work process efficiency, Improves employee skill base and increases job assignment flexibility over time, Reduced boredom and complacency, Increased productivity & quality. Reduced absenteeism & turnover.
- Ergonomics awareness training must be identified and delivered to all employees, whether internally or externally. It will aid in recognizing that the worker is aware of the risks associated with the associated work.
- A standard operating procedure will be developed, which will include all identified risk and reduction methodologies, as well as engineering control and PPE usages.
- Wrist braces support your wrist in a neutral position, which may help bring relief to wrist discomfort and pain. They prevent repetitive movements, which is helpful for conditions such as arthritis and tendonitis. Some wrist braces also reduce compression of the median nerve, which causes carpal tunnel syndrome.
- After consulting with health care specialists or a physiotherapist, has to suggest who are all exposed in the risky work.
- Compression socks work by gently applying pressure to the lower limbs, increasing blood flow and preventing blood pooling in these areas. They compress not only the leg muscles but also the larger leg veins, reducing their diameter and increasing the rate at which blood flows through them.
- After consulting with health care specialists or a physiotherapist, has to suggest who are all exposed in the risky work.
- Stretching at work can reduce fatigue by increasing blood supply and nutrients to your muscles.
- Stretching is waking up your muscles to let them know that they will be performing a job. Stretching warms up the muscles by working them gently – just like an athlete.
- Stretching can improve posture by allowing muscle tissues to realign, thus reducing effort to achieve and maintain good posture. Often these muscles have adapted poorly to effects of gravity and poor postural habits.
- Stretching also helps opposing muscle groups work in a more coordinated fashion.

VII. CONCLUSION

In this study and working posture ergonomics risk assessment; we took in cutting, sewing, finishing, and packing activities in the ladies garments division in the garment manufacturing industry. The results of the ergonomics risk assessment using the REBA approach were medium, high, and extremely high risk. This necessitates quick changes in the workplace in accordance with proposed control measures, as well as the potential for improvements and mobility. Workers interactions resulted in long-term knee discomfort, back pain, exhaustion, and excessive tiredness, among other things.

Many personnel are unaware of the seriousness of the situation and lack knowledge of their responsibilities. Risk assessments can protect workers from serious musculoskeletal disorders and injuries at work that could be reduced or avoided with ergonomic improvements as by suggested.

Continuous risk assessment, worker training and education, and workplace improvement will undoubtedly reduce the very high risk to a lower level and change the worker mentality to increase production in a more straightforward and uncomplicated manner.

REFERENCES

- [1] Al Madani, D., & Dababneh, A. (2016). Rapid entire body assessment: a literature review. *American journal of engineering and applied sciences*, 9, 107–118.
- [2] Hignett, s., & Mcatamney, l. (2000). Rapid entire body assessment (reba). *Applied ergonomics*, 31, 201–205.
- [3] David, g. C. (2005). Ergonomic methods for assessing exposure to risk factors for work-related musculoskeletal disorders. *Occupational medicine*, 55, 190-199.
- [4] Fallentin, N., Kilbom, Å., Viikari-Juntura, E., & Wærsted, M. (2000). Evaluation of physical workload standards/guidelines from a nordic perspective. In *proceedings of the human factors and ergonomics society annual meeting (vol. 44, pp. 6-429-426-432): sage publications*.
- [5] Gade, R., Chandurkar, P., Upasani, H., & Khushwaha, d. (2015). Ergonomic intervention to improve safety and productivity. *International journal on textile engineering and processes*, 1, 79-88.
- [6] Karhu, O., Kansu, P., & Kuorinka, I. (1977). Correcting working postures in industry: a practical method for analysis. *Applied ergonomics*, 8, 199-201.
- [7] Keawduangdee, P., Puntumetakul, R., Chatchawan, U., Kaber, D., & Siritaratiwat, W. (2012). Prevalence and associated risk factors of low-back pain in textile fishing net manufacturing. *Human factors and ergonomics in manufacturing & service industries*, 22, 562-570.
- [8] Nemailal Tarafder , Study of ergonomics in textile industry , ex-emeritus professor, department of textile engineering, hooghly engineering and technology.College, hooghly, west bengal, india
- [9] Yordán Rodríguez*, Silvio Viña And Ricardo Montero , A practical tool for assessing work-related musculoskeletal disorders faculty of industrial engineering, josé a. Echeverría polytechnic institute, havana, cuba
- [10] Olcay polat , Ergonomic risk assessment of workers in garment industry by, can b. Kalayci. Department of industrial engineering, pamukkale university, turkey
- [11] Yousaf Ayub, Zahid Abbas And Shah ,Assessment of work related musculoskeletal disorders in manufacturing industry * institute of quality and technology management, university of the punjab, lahore, Pakistan

- [12] Bruce P. And Bernard, M.D., M.P.H. U.S , Musculoskeletal disorders and workplace factors - a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back Department of health and human services, public health service, centers for disease control and prevention, national institute for occupational safety and health
- [13] <https://www.textileschool.com/193/garment-production-process/>
- [14] <https://www.ccohs.ca/oshanswers/diseases>
- [15] www.indiantextilejournal.com
- [16] medical history checklist: symptoms survey for work-related musculoskeletal disorders (wmsds) : osh answers
- [17] ccohs: sitting, standing, ...
- [18] www.morganmaxwell.co.uk
- [19] www.ncbi.nlm.nih.gov/pmc/articles/pmc5546841/
- [20] Occupational safety and health administration, u.s. Department of labor.
- [21] Hita-Gutiérrez, Marta Gómez-Galán , Manuel Díaz-Pérez And Ángel-Jesús Callejón-Ferre , An overview of rebra method applications in the world manuel

