

# **PERBAIKAN KONDISI KERJA DENGAN PENDEKATAN ERGONOMI TOTAL MENURUNKAN KELUHAN MUSKULOSKELETAL DAN KELELAHAN SERTA MENINGKATKAN PRODUKTIVITAS DAN PENGHASILAN PERAJIN PENGECATAN LOGAM DI KEDIRI-TABANAN**

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## **ABSTRAK**

Perubahan ekonomi dunia menuntut daya saing setiap perajin khususnya di Bali. Salah satu daya saing yang diusahakan adalah produksi tepat waktu. Produksi tepat waktu sebagian besar dilakukan dengan kerja lembur seperti perajin pengecatan logam di Kediri Tabanan. Hal ini disebabkan produktivitas dan penghasilan mereka masih di bawah standar. Untuk itu diperlukan suatu perbaikan dengan pendekatan ergonomi sehingga mampu bersaing, manusiawi dan berkelanjutan. Banyak perbaikan sudah dilakukan tetapi masih terjadi masalah sehingga diperlukan perbaikan secara komprehensif. Salah satu cara perbaikan adalah dengan melalui pendekatan ergonomi total. Tujuan untuk mengetahui pengaruh pendekatan ergonomi total terhadap keluhan muskuloskeletal dan kelelahan serta produktivitas dan penghasilan perajin. Subyek penelitian adalah 24 karyawan pengecatan kerajinan logam di Kediri Tabanan pada bulan September 2007 – Maret 2007 dengan rancangan sama subyek. Kondisi kerja diperbaiki dengan model pendekatan ergonomi total sehingga diperoleh bentuk perbaikan yang paling optimal. Hasil menunjukkan ada penurunan keluhan muskuloskeletal 5,53 % dan penurunan kelelahan 6,79 % secara bermakna ( $p < 0,05$ ). Produktivitas karyawan meningkat 61,36% dan penghasilan perajin meningkat 55,29% secara bermakna ( $p < 0,05$ ). Perubahan yang terjadi sebagai dampak dari perbaikan kondisi kerja dengan model pendekatan ergonomi total lebih besar terjadi pada produktivitas dan penghasilan. Disimpulkan pendekatan ergonomi total menurunkan keluhan muskuloskeletal dan kelelahan serta meningkatkan produktivitas dan penghasilan perajin. Disarankan untuk menerapkan model pendekatan ergonomi total pada industri yang lain dan mendorong partisipasi aktif karyawan dalam perbaikan kondisi kerja.

Kata kunci : pendekatan ergonomi total, keluhan muskuloskeletal dan kelelahan, produktivitas dan penghasilan

## **PENDAHULUAN**

Situasi perekonomian dunia menyebabkan menurunnya aktivitas industri pariwisata Bali beserta industri pendukungnya. Di tengah menurunnya industri pariwisata, masih ada kelompok industri kecil yang mampu bertahan seperti industri kerajinan logam dan menciptakan lapangan kerja baru (Anonim, 2004). Peningkatan pesanan menyebabkan perajin memberlakukan jam lembur khususnya menjelang batas waktu penyeteran produk.

Perajin industri pengecatan kerajinan logam sebagian besar karyawan wanita. Mereka mengecat dalam sikap kerja duduk membungkuk di kursi maupun jongkok di lantai

dengan sistem borongan. Studi pendahuluan menunjukkan keluhan muskuloskeletal meningkat 23, 21 %, kelelahan meningkat 35,33 %, produktivitas mencapai 48 % dan penghasilan 30 % dari kondisi ideal. Hal inilah menimbulkan kerja lembur untuk memenuhi target produktivitas perajin.

Sistem lembur berkelanjutan dapat meningkatkan stres dengan segala dampaknya sehingga mengurangi penghasilan, menurunkan produktivitas. Usaha meningkatkan produktivitas melalui pendekatan ergonomi telah banyak dilaksanakan pada berbagai industri. Akan tetapi pendekatan yang dilaksanakan masih bersifat sebagian. Oleh karena itu diperlukan adanya perbaikan secara menyeluruh melalui pendekatan ergonomi total. (Manuaba, 2006).

Pendekatan ergonomi total menekankan penggunaan pendekatan sistemik, holistik, interdisipliner dan partisipasi (SHIP approach) dalam analisis masalah ergonomi dan merumuskan rencana kerja serta memilih intervensi melalui penerapan teknologi tepat guna (TTG). Intervensi ergonomi dilakukan secara menyeluruh sehingga menghasilkan intervensi terbaik dengan dampak seminimal mungkin (Manuaba, 2006). Perbaikan ergonomi sudah dilaksanakan oleh berbagai peneliti pada berbagai bidang. Sementara perbaikan pada karyawan industri pengecatan kerajinan logam belum ditemukan.

Penerapan pendekatan ergonomi total dianjurkan oleh beberapa ahli karena metode yang digunakan mampu menciptakan kondisi kerja manusiawi, kompetitif dan berkelanjutan sehingga meningkatkan produktivitas dan penghasilan karyawan maupun pengusaha (Manuaba, 2005). Dampak lebih lanjut adalah pemberdayaan karyawan sehingga mampu memperbaiki kondisi kerjanya sendiri dengan sumber daya yang dimiliki. Berdasarkan hal tersebut, maka intervensi dengan pendekatan ergonomi total perlu diterapkan pada industri kecil seperti industri pengecatan logam.

Penelitian ini bertujuan mengetahui pengaruh pendekatan ergonomi total serta memberi masukan dalam upaya peningkatan produktivitas dan penghasilan perajin. Model pendekatan ergonomi total yang dipergunakan dapat diterapkan secara langsung oleh perajin sehingga mampu meningkatkan kesejahteraan.

## **MATERI DAN METODE**

Penelitian dilaksanakan pada industri pengecatan kerajinan logam di Kediri Tabanan. Penelitian eksperimental sama subyek ini dilakukan pada bulan September 2006 – Mei 2007

dengan populasi karyawan wanita pada industri pengecatan kerajinan logam di Kediri Tabanan. Sampel berjumlah 24 orang yang dipilih secara acak stratifikasi

Sampel terpilih diberikan perlakuan kondisi kerja dengan model pendekatan ergonomi total. Model yang dipergunakan adalah ceramah dan lokakarya untuk mencari alternatif perbaikan yang paling optimal. Data keluhan muskuloskeletal dan kelelahan diukur dengan kuesioner Nordin Body Map dan 30 item kelelahan, produktivitas dan penghasilan dihitung berdasarkan model yang dihasilkan. Perubahan keluhan muskuloskeletal, kelelahan, produktivitas dan penghasilan antara sebelum dan sesudah perbaikan dibandingkan dengan uji statistik serta analisis *cost-benefit*.

## **HASIL DAN PEMBAHASAN**

Subjek penelitian terdiri dari 24 sampel, tetapi yang mengikuti penelitian sampai akhir adalah 20 orang karyawan dan 4 orang sisanya *drop out*. Seluruh subjek dalam kondisi optimal untuk bekerja berdasarkan pemeriksaan fisik, tekanan darah, denyut nadi istirahat dan indeks massa tubuh. Tinggi siku subjek saat duduk di kursi adalah  $68,4 \pm 6,7$  dan lebih tinggi dari rerata ketinggian meja kerja sehingga mempengaruhi sikap kerja. Umur subjek 17 – 50 tahun merupakan usia kerja produktif dengan metabolisme yang konstan (Wenger, 2006). Hal ini menyebabkan tidak adanya perbedaan metabolisme antara usia rendah dengan usia tinggi. Lingkungan kerja subjek relatif sama antara sebelum dan sesudah perlakuan sehingga subjek bekerja dalam kondisi yang sama ( $p > 0,05$ ).

Penerapan pendekatan ergonomi total kepada subjek diberikan bersama-sama dengan mitra bestari lain dalam bentuk ceramah dan lokakarya sehingga menghasilkan perbaikan paling optimal (Manuaba, 2006). Perbaikan yang dilakukan adalah : (1) mengatur sikap kerja; (2) memberikan istirahat singkat; (3) memberikan minum teh; (4) memasang papan informasi; dan (5) menggunakan masker saat mengecat.

Perubahan kondisi kerja menyebabkan sel otot yang bekerja memperoleh kesempatan melakukan pemulihan secara optimal. Pemulihan diperlukan oleh sel untuk mengembalikan keadaan mikrotrauma. Pengaturan sikap kerja menyebabkan otot berkontraksi optimal, sehingga sikap kerja paksa berkurang. Pengaturan istirahat memberikan kesempatan pemulihan tubuh secara optimal. Aktivitas peregangan saat istirahat memungkinkan sel mengalami kontraksi relaksasi secara bergiliran. Apalagi disertai adanya informasi yang jelas tentang proses kerja dan upah tiap model. Pemberian air teh manis dengan takaran sesuai berat badan dan lama kerja bertujuan menjaga asupan

zat makanan tetap optimal. Penggunaan masker disepakati melalui proses partisipasi karyawan sehingga bisa diterima semua pihak.

Keluhan muskuloskeletal setelah perlakuan menurun secara kualitas dan kuantitas. Perlakuan berpengaruh terhadap penurunan keluhan muskuloskeletal dari  $33,03 \pm 2,73$  menjadi  $31,30 \pm 3,49$  ( $p < 0,05$ ). Keluhan yang muncul pada industri pengecatan logam berbeda dengan keluhan pada pekerja semikonduktor yang menggunakan ban berjalan, karena mengecat mendapat kesempatan istirahat singkat secara teratur. Hasil penelitian Barbini, et.al. (2003) lebih banyak menimbulkan keluhan pada punggung (81%) dibandingkan pengecatan logam (16,4 %) karena adanya sikap kerja statis, kerja repetitif dan monoton tanpa adanya waktu istirahat untuk relaksasi.

Penurunan skor kelelahan subjek setelah diberikan perlakuan merupakan hasil perbaikan kondisi kerja dengan pendekatan total. Rerata skor kelelahan menurun dari  $37,77 \pm 5,95$  menjadi  $35,37 \pm 5,33$  ( $p < 0,05$ ). Hasil tersebut berbeda dengan perubahan kelelahan pada karyawan industri lainnya (Husein, dkk., 2006). Ini menunjukkan pekerjaan mengepak lebih banyak menggunakan fisik, sementara pekerjaan pengecatan lebih banyak memerlukan konsentrasi dan motivasi karyawan karena produk yang dihasilkan merupakan karya seni.

Secara keseluruhan pengaruh kondisi kerja dengan pendekatan ergonomi total terhadap penurunan keluhan muskuloskeletal adalah 5,53% dan penurunan kelelahan adalah 6,79%. Hasil ini sesuai dengan penelitian lain yang menggunakan pendekatan ergonomi maupun pendekatan SHIP. Pendekatan SHIP menurunkan keluhan muskuloskeletal 33,30% dan kelelahan 53,43% (Sutajaya, 2005). Perbaikan kondisi kerja perajin perak menyebabkan penurunan gangguan muskuloskeletal 40,28% dan kelelahan sebesar 45,77% (Tunas, 2005).

Dampak akhir dari perbaikan kondisi kerja adalah peningkatan produktivitas dan penghasilan perajin. Uji perbedaan menunjukkan adanya peningkatan produktivitas dari  $1,32 \pm 0,49$  menjadi  $2,13 \pm 0,99$ . Dengan demikian perbaikan kondisi kerja dengan pendekatan ergonomi total meningkatkan produktivitas karyawan ( $p < 0,05$ ). Besar pengaruh perbaikan kondisi kerja terhadap penurunan istirahat curian adalah 59,64% dan peningkatan produktivitas adalah 61,36%.

Hasil ini ternyata sama dengan penelitian SHIP yang meningkatkan produktivitas sampai 47,39% (Sutajaya, 2005). Perbaikan dengan pendekatan ergonomi saja hanya sedikit meningkatkan produktivitas yaitu 15,38% (Tunas, 2005). Dengan demikian pendekatan

ergonomi total lebih berorientasi pada peningkatan produktivitas sebagai tujuan akhir dibandingkan hanya menurunkan keluhan muskuloskeletal dan kelelahan.

Uji perbedaan menunjukkan rerata penghasilan karyawan meningkat 55,29% ( $p < 0,05$ ). Rerata penghasilan pengusaha setiap hari sebelum perlakuan adalah Rp. 118.767,00 dan sesudah perbaikan adalah Rp. 182.100,00. Saldo keuntungan pengusaha dihitung berdasarkan penghasilan pengusaha dikurangi biaya investasi pengadaan alat dan bahan. Sedangkan saldo keuntungan setelah perbaikan kondisi kerja dihitung berdasarkan penghasilan pengusaha dikurangi biaya investasi perbaikan kondisi kerja, investasi alat dan bahan. Peningkatan penghasilan dapat menjadi faktor utama dalam melakukan perbaikan sehingga menjadi motivasi internal dari karyawan. Hanya saja kerja lembur diupayakan seminimal mungkin. Upaya perbaikan dengan pendekatan ergonomi total mampu meningkatkan penghasilan dengan mengurangi jam lembur yang ada selama ini.

## **SIMPULAN DAN SARAN**

Berdasarkan hasil dan pembahasan, maka perbaikan kondisi kerja dengan pendekatan ergonomi total menurunkan keluhan muskuloskeletal dan kelelahan serta meningkatkan produktivitas dan penghasilan karyawan dan pengusaha kerajinan logam di Kediri Kabupaten Tabanan. Pengaruh model pendekatan ergonomi total lebih besar pada peningkatan produktivitas dan penghasilan dibandingkan dengan penurunan keluhan muskuloskeletal dan kelelahan.

Berdasarkan simpulan tersebut maka model perbaikan kondisi kerja dengan pendekatan total dapat digunakan pada kelompok industri lain. Karyawan hendaknya lebih diberdayakan melalui partisipasi sehingga mau dan mampu melaksanakan perbaikan kondisi kerja secara optimal.

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# **TOTAL ERGONOMIC APPROACH TO THE IMPROVEMENT OF WORKING CONDITION DECREASES MUSCULOSKELETAL COMPLAINTS AND FATIGUE AND INCREASES PRODUCTIVITY AND INCOME OF THE IRON WORK PAINTING ARTISANS AT KEDIRI-TABANAN**

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## **ABSTRACT**

Global economic situation necessitates competitive power of every artist to survive particularly in Bali. One of the competitive power that should be endeavored is on time production. On time production has been, so far, achieved by overtime works such as done by the artisans of iron work painting at Kediri Tabanan. This condition was caused by low of productivity and income of the artisans. So an improvement is needed through an ergonomic approach to increase their competitive power and their working condition more humane, competitive and sustainable. Many improvements had been done, but there are still problems to cope with that need a comprehensive improvement. One of the solution is, among others, a total ergonomic approach. This research was done to find out the effect of total ergonomic approach on musculoskeletal complaints, fatigue, productivity and income of artisans. The subject were 24 artisans at iron works painting industry at Kediri Tabanan on September 2006–March 2007 using treatment by subject of experimental design. The working condition was developed through total ergonomic approach model to get the most optimum improvement. The result showed that musculoskeletal complaints decreased 5.53% and fatigue decreased 6.79% ( $p < 0.05$ ). Productivity of artisans increased significantly 61.36% and income increased 55.29% ( $p < 0.05$ ). The magnitude of changes that occurred on productivity and income were higher than musculoskeletal complaints and fatigue based on total ergonomic approach model. It was concluded that total ergonomic approach decreased musculoskeletal complaints and fatigue, increased productivity and income of artisans. It was suggested to apply total ergonomic approach model on other industries and encourage for active participation of artisans on working condition improvement.

**Keywords:** total ergonomic approach, musculoskeletal complaints and fatigue, productivity and income

## **INTRODUCTION**

Global economic situation has decreased the activity of tourism industry in Bali and its supporting sectors. Amid the decrease of tourism industry, there are still some small scale industries that could survive such as iron work handy craft and created new job opportunity (Anonim, 2004). The increase of order made the artisans work overtime particularly one week before dead line of shipping.

Most of the artisans were female. They have to paint in sitting position either on the chair or on the floor and work based on wholesale payment system. A preliminary study indicated that the score of musculoskeletal complaints increased 23.21%, fatigue increased 35.33% and productivity was 48% from ideal condition. This condition made the artisans work overtime to meet the target of productivity.

Continuous overtime work load could increase stress followed by various impacts that may reduce their income and decrease productivity. Efforts to increase productivity through an ergonomic approach have been done by various industries. But, the approach seems to be partial. Hence, a comprehensive improvement through total ergonomic approach is needed (Mauaba, 2006).

Total ergonomic approach pointed out the application of systemic, holistic, interdisciplinary and participatory (SHIP approach) to analyze working condition. A comprehensive ergonomic intervention design should be taken into consideration to get the best improvement with minimum impact.

Implementation of total ergonomic approach was approved by many researchers because the method could make working condition more humane, competitive and sustainable in order to increase productivity and income of artisans (Manuaba, 2005). The outcome is empowerment of the artisans in order to improve their working condition based on their own resources. Studies on ergonomic improvements have been done by many researchers in many sectors. Meanwhile a study on ergonomic improvement at iron work painting has never been done yet. Based on that situation, total ergonomic approach needs to be implemented at small scale industry such as at iron work painting industry.

The objective of this research is to find out the effect of total ergonomic approach and to give feedback to increase productivity and income. The total ergonomic approach model could be applied directly by the artisans so that they can improve their welfare.

## **MATERIALS AND METHODS**

The research was conducted at iron work painting industry at Kediri Tabanan on September 2006 – March 2007. The research design was experimental research with treatment by subject. The population included the female artisans of iron work painting. The subjects were 24 artisans who were chosen by stratified random sampling.

The subjects were intervened by total ergonomic approach working condition. The model was implemented through lecturing and workshop to find out the best improvement



alternatives. Musculoskeletal complaints and fatigue data were assessed using Nordic Body Map and 30 Item questionnaire, productivity and income were calculated based on the produced model. The change of musculoskeletal complaints and fatigue score, productivity and income were compared before and after intervention using statistics and cost benefit analysis.

## **RESULTS AND DISCUSSIONS**

The subjects were 24 samples, but only 20 samples completed the research and 4 samples drop out. All of the subjects were in optimum condition to work based on physical examination, blood pressure, resting pulse rate and body mass index. Height of elbow while sitting on the chair was  $68.4 \pm 6.7$  and higher than the mean of table height that caused the subject work and sat in bending work posture. Age of subjects varied from 17 to 50 years old as productive age with a stable basal metabolism rate (Wenger, 2006). This condition caused no metabolic differences between younger and older age. Working environment affects productivity of artisans. Convenience was affected by lighting, temperature, humidity, noise and flow of wind. Work environment was not different significantly so the subject could work in the same condition ( $p > 0.05$ ).

The implementation of intervention was done together with other stakeholders through lecturing and workshop to get the best improvement (Manuaba, 2006). The improvement done included: (1) arranging the height of table and put foot rest; (2) giving rest breaks; (3) providing food and drink during breaks; (4) putting blackboard at the walls; and (5) to prescribing the use of masker during work.

Improvement of working condition caused the contracted muscle cell have optimal recovery process. Recovery is needed for cell to recover micro trauma condition. Work posture arrangement caused an optimal muscle contraction and unnatural posture reduced. Rest arrangement allowed the body to recover itself optimally. Stretching activity during rest allowed contraction and relaxation of cell in turn. The contraction and relaxation of blood vessels supported the distribution of oxygen and nutrition. Optimal intake was needed by cell for optimal recovery. Stretching condition during rest was done happily and with smile, so relieved stress and drove the motivation higher. Clear information about wages and work process supported for better working condition. Provision of sweet tea as an adjuvant could maintain state of nutrition. The use of masker was agreed by all artisans through participation, so could be accepted by all stakeholders.

Musculoskeletal complaints after intervention decreased in quantity and quality. Working condition improvement decreased musculoskeletal complaints significantly from  $33.03 \pm 2.73$  to  $31.30 \pm 3.49$  ( $p < 0.05$ ). Musculoskeletal complaints were different from artisans of semiconductor industry that used chain system, because the artisans had regular short breaks. Barbini, et.al. (2003) reported that musculoskeletal complaints were frequent on back (81%) compared to iron work painting (16.4%) because of static work posture, repetitive and monotonous work without any rest time for relaxation.

The decrease of fatigue's score on subject resulted from the total ergonomic approach intervention. Mean of fatigue's score decreased significantly from  $37.77 \pm 5.95$  to  $35.37 \pm 5.33$  ( $p < 0.05$ ). The result was different from other industry employees based on the process of job (Husein, et.al., 2006). It indicates that packing work needs more physical activity compared to painting work as an art work that needs more concentration and diligence.

Comprehensively, the effect of total ergonomic approach on decreasing of musculoskeletal complaints was 5.53% and decreasing of fatigue was 6.79%. The result was similar to other research that used ergonomic approach or SHIP approach. SHIP approach could decrease musculoskeletal complaints 33.30% and fatigue 53.43% (Sutajaya, 2005). Silver working condition improvement decreased musculoskeletal complaints 40.28% and fatigue 45.77% (Tunas, 2005).

The final outcome of working condition improvement increased productivity and income of artisans. Statistic test of productivity showed a mean of productivity increase from  $1.32 \pm 0.49$  to  $2.13 \pm 0.99$ . Thus, the total ergonomic approach has an effect to increase productivity of artisans. The magnitude of improvement effect was about 61.36% ( $p < 0.05$ ).

The result was similar to research of SHIP that could increase productivity 47.39% (Sutajaya, 2005). Improvement of working condition through ergonomic aspect could increase productivity 15.38% only (Tunas 2005). This result showed that total ergonomic approach was more oriented to increase productivity as final goal compared to an effort to decrease musculoskeletal complaints and fatigue. Improvement was done to empower the artisans in order to possess the ability in designing and improving their own working condition.

The objective of working condition change was to increase the income acceptable to the workers. Statistic test showed that total ergonomic approach has an effect to increase employee's income until 55.29% ( $p < 0.05$ ). Mean of employer's income increased from Rp.

118,767.00/day to Rp. 182,100.00/day. Benefit of employers after intervention was calculated on employer's income subtracted by investment cost, tools and material. So, during intervention the employer investment increased. Increases of employee's and employer's income were the main objective of ergonomic intervention. The outcomes could be an internal motivation for themselves. In this case, total ergonomic approach was able to fulfill the need of artisans and employer in working condition improvement by increasing productivity and income and reducing overtime work.

The things that should be avoided is such motivation that drives the employee to work for much income without any attention to their health and safety. Total ergonomic approach is designed to minimize health and safety cases in order to enhance the income of employee through active participation of all stake holders.

## CONCLUSIONS

Based on the result and discussion it could be concluded that the improvement of working condition based on total ergonomic approach decreased musculoskeletal complaints and fatigue, and increased productivity and income of artisans and employers of iron works painting employee at Kediri Tabanan. The effect was higher on productivity and income of employee and employer than musculoskeletal complaints and fatigue.

Based on the conclusion it is suggested that the model should be implemented intensively at other iron work industries. The employee should be empowered through active participation in order to improve their working condition themselves optimally.

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