

The Implementation of the Policy, Organising, Planning and Implementing, Measuring Performance, Audit and Reviewing (POPMAR) Model in Occupational Health and Safety Risk Management in an Indonesian Batik Company

Implementasi Policy, Organising, Planning and Implementing, Measuring Performances, Auditing, and Reviewing (POPMAR) Model dalam Manajemen Risiko Keselamatan dan Kesehatan Kerja di sebuah Perusahaan Batik di Indonesia

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ABSTRACT

Introduction: In 2009, UNESCO declared Batik Indonesia as an Intangible Cultural Heritage of Humanity. This study examines the occupational health and safety hazards and risks that arise in a Batik company based on a case example of a Batik company in Surakarta, Indonesia. In Indonesia, Batik is categorized as traditional attire. Two kinds of Batik are produced - Batik tulis (traditionally handcrafted) and Batik printing, which uses specific printing tools. The UK Health Safety Executive (HSE) risk assessment framework is referred to in this study, which consists of: hazard identification, population exposure, risk evaluation, precaution development, recording findings, and regular appraisal of systems. **Methods:** Both observation and interviews (of workers) at the Batik company were utilized for this study as well as an independent risk assessment. **Results:** The findings highlighted physical, ergonomic, chemical, mechanical, and biological hazards, originating from the materials, tools, and working methods utilized in the batik production. **Conclusion:** Many of the issues highlighted by this study can be addressed via in-depth risk assessment, using the POPMAR model to frame the activities. This approach can create a positive pathway, leading to a continuous cycle of improvement which puts the workers' health at the forefront of the business activities.

Keywords: Batik, workers, hazard identification, HSE Model, risk management

ABSTRAK

Pendahuluan: UNESCO mendeklarasikan Batik Indonesia sebagai warisan dunia tak benda pada tahun 2009. Penelitian ini bertujuan untuk mengidentifikasi bahaya dan risiko K3 yang ada di sebuah perusahaan batik di Surakarta, Indonesia. Di Indonesia, batik dapat dikategorikan sebagai pakaian tradisional. Perusahaan ini memproduksi dua jenis batik – batik tulis (dibuat secara manual oleh perajin) dan batik printing yang menggunakan peralatan printing spesifik. Framework penilaian risiko yang berasal dari The Health Safety Executive (HSE) UK digunakan dalam penelitian ini yang terdiri dari identifikasi bahaya, populasi terpajan, evaluasi risiko, pengembangan tindakan pengendalian, pendokumentasian temuan, dan penilaian sistem secara berkala. **Metode:** Observasi dan interview pada pekerja digunakan dalam penelitian ini. Observasi dilakukan pada berbagai tahapan proses produksi batik. Interviews dilakukan pada 6 pekerja yang mewakili masing-masing tempat kerja. **Hasil:** observasi langsung menemukan bahwa material, peralatan, dan metode kerja yang digunakan dari proses produksi batik menghasilkan bahaya fisik, ergonomi, kimia, mekanik, dan biologi. **Simpulan:** permasalahan yang terjadi di perusahaan dapat diatasi dengan pemahaman yang baik mengenai risiko serta kajiannya dan menerapkan pemodelan POPMAR dalam aktivitas pekerjaan. Hal ini akan membuat pola yang positif yang dapat berkontribusi dalam perbaikan yang berkelanjutan serta menempatkan kesehatan pekerja sebagai prioritas dalam segala aktivitas.

Kata kunci: HSE Model, identifikasi bahaya, manajemen risiko, pekerja batik

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INTRODUCTION

Batik Indonesia was declared an Intangible Cultural Heritage by UNESCO in 2009. Batik is very much part of the Javanese tradition and The Batik Gaffney (2021) declared Java Island in Indonesia as having the best Batik in the world.

Batik is a method of traditional clothes production involving hot dyed wax being applied to a garment. Handmade batik is created by craftsmen who draw the design, cover the design with hot wax, dye the clothes with the intended colour and then immerse the clothes in hot boiling water. This process is repeated until the garments have the desired colour (UNESCO, 2021).

The Indonesian nation believes that Batik is inseparable to their culture with a deep meaning and guiding philosophy attached to it (Trixie, 2020). Today Batik can also be produced using machine techniques, but the product is not associated the individuality and characteristics of the handcrafted fabric.

According to Lestari (2020), the presence of various hazards in the Batik workplace, including chemical, physical, ergonomic, biological and psychosocial hazards are not only dangerous but can result in lost working hours, productivity reduction and disruption which can lead to financial impacts as well as health impacts. For example, many chemicals are utilised in the production of Batik including Sodium bicarbonate, Sodium carbonate, Sodium hexametaphosphate, Urea, Sodium hydrosulphite, White vinegar, Acetic acid, Ammonium sulphate, and Sodium silicate (Dyrenforth, 2003). Reactive dyes, namely, Remazol, Naphthol, and Indigosol

are also included in the Batik production process (Aryanti, 2015).

It has been documented that exposure to the chemicals used in Batik will affect the skin, potentially causing irritation, dryness, itchiness, redness, chemical burns, ulcers, erythema, and occupational dermatitis. Moreover, the chemical fumes can affect the respiratory system which can cause coughing, fever, and even asphyxiation (Lestari, 2010). A study by Soebaryo and Budianti (2020) concluded that batik workers often have dermatitis because of the allergen and irritants from chemicals used in the industry.

As well as the potential exposure to chemicals, Batik craftsmen also have to work in awkward and static positions, which can impact their arm, shoulder, wrist, back, knee, thigh, and foot movement. There is evidence that these awkward positions are associated with Musculoskeletal Disorders (MSDs) (Melese *et al.*, 2020). A study by Maharani *et al.* (2020), highlighted that the chairs used by Batik workers, known as ‘Dingklick’, were not ergonomic, and could contribute to musculoskeletal disorders.

A further study conducted by Sari (2015) underpins the issues associated with Batik production. In their research, they found 124 different health and safety concerns including accidents involving hot liquid wax, molten turpentine splashes and sharp tool scratches.

The Indonesian government regulates the health and safety management system through the “UU. No 1 Tahun 1970” (The Regulation concerning safety at the workplace) and “SMK3 PP. No 50 Tahun 2012”

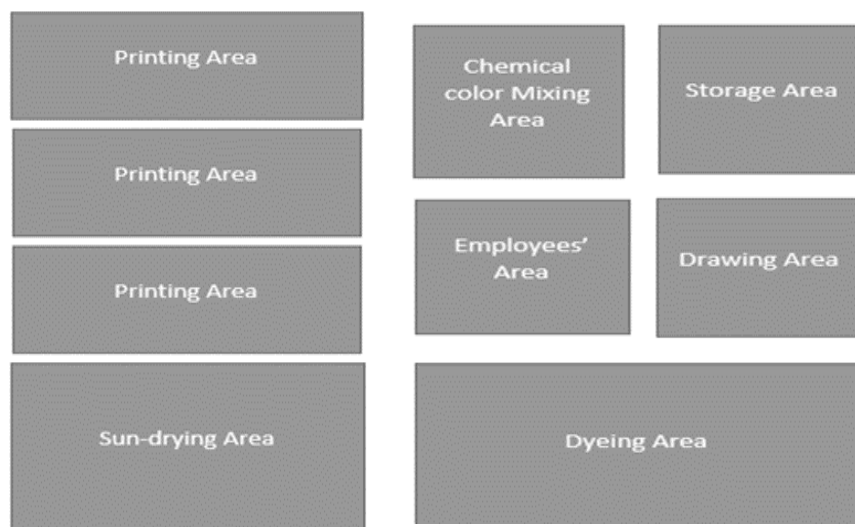


Figure 1. The Company Workplace Layout

(The Health and Safety Management System within Government Regulations). Data from the Ministry of the Industry, Republic Indonesia (2021) shows that there are an estimated 100,000 workers in batik, with the numbers growing every year. In the study area of Surakarta, Indonesia, there are around 72 batik industries which employ 7.000 people (Lestari, 2010).

The Health and Safety Executive (2016), proposed that health and safety management systems become the key tool for managing workplace health and safety. The HSE management model, based on HS(G)65, includes areas of: “policy, organising, planning, measuring performance, and audit and review of performance (Health and Safety Executive, 2013). This management system involves the whole organization and includes assessment of business structure, business activities, responsibilities, practices, processes, procedures and resources. The process also involves mapping and evaluating health and safety achievements, and maintaining the health and safety policy of the organization.

This study aimed to assess the occupational health and safety hazards and risks utilising the POPMAR Model (HSG65) to evaluate the adopted risk management in the selected company. The company chosen for the research study was based in the Surakarta region and was founded in 2000. Its goods are distributed all around Indonesia. The factory is located in a small village and all of the workers employed at the site are from this village.

METHODS

The methods utilized for this study were direct observation of the working areas to identify the hazards followed by semi-structured interviews to explore the workers opinions with respect to their working environment and health and safety implications. An independent risk assessment was also carried out.

The working areas observed included the dyeing, sun-drying, printing, drawing, chemical color mixing, and Batik tulis areas. The observation data was obtained through both direct observations as well as video footage. Interviews were obtained from six workers, each being a designated leader for their working area. These workers were chosen for their relevant skills, experience, and knowledge of their particular areas of production. The results of the interviews were transcribed with thematic analysis utilized.

Hazard Severity (a)	Likelihood of Occurrence (b)
1- Trivial (e.g discomfort, slight bruising, self-help recovery)	1- Remote (almost never)
2- Minor (e.g small cut, abrasion, basic first aid need)	2- Unlikely (occurs rarely)
3- Moderate (e.g strain, sprain, incapacitation > 3 days)	3- Possible (could occur, but uncommon)
4- Serious (e.g fracture, hospitalisation > 24 hrs, incapacitation > 4 weeks)	4- Likely (recurrent but frequent)
5- Fatal (single or multiple)	5- Very Likely (occurs frequently)

Source: US EPA (2009)

Figure 2. Severity and Likelihood Scale

$$\text{Risk} = \text{Likelihood} \times \text{Severity}$$

An independent risk assessment was also carried out for this study, based on the HSE UK HSG65 model, to define the source of the hazards involved. Figure 2 below shows the severity and likelihood scale utilized.

The risk assessment considered the working frequency, duration of the work, and the intensity of each task. The risk given a numerical measure through multiplying the likelihood of an occurrence by the severity of the outcome.

RESULTS

Risk Assessment Results

Tables 1 below show the hazards found in the dyeing area, the printing area, the chemical colouring area and the batik tulis area.

Observation Results

Sun-drying Area

The processes in this area involving carrying and setting out the fabrics. This involved repetitive lifting, bending, and squatting. There was a particular impact from the heat and one worker observed was repetitively wiping sweat away with his already wet clothes. The lifting and carrying was all done manually without any lifting aids.

In the dyeing area there was a repetitive immersing process in the dyeing pond which consisted of coloured liquids. It was observed that a worker had to repeatedly stretch his hands and



Source: US EPA (2009) **Figure 3.** Risk Measurement

What are the Hazards?	Hazard Source (Equipment/Process)	Who might be harmed and how?	Likelihood	Severity	Risk	Effects	Existing Control

Figure 4. Risk Assessment

arms to completely immerse the fabrics. The edge of the dying pond was low, which meant the worker needed to repeatedly bend over to immerse the fabrics. The immersing process was conducted with bare hands and the worker wore sandals which did not completely protect the feet. Written instructions were observed in this area that people should be very careful due to the wet and slippery floor conditions.

The second task performed in the dyeing area was to immerse the garments into hot water. A worker sat and waited for the immersed clothes to boil. He repeatedly fanned himself with his clothes. It was observed that all the workers in this space wore open sandals.

Drawing Area

The drawing area was divided into two parts: computer and manual drawing. The computer-based drawing area appeared to be disorganized and a dingklik chair in which the worker was sitting for long periods of time.

In the manual drawing room there was more movement, with the worker moving around the table. The worker was repeatedly bending his back. However, positively, a worker was singing and humming, as if he was enjoying himself.

Printing Area

The fabrics were placed on five long rows of tables in the printing area. The coloured dye was poured into the wooden printing tool and applied to the fabric. The process was observed to be repetitive. The staff in this area were not wearing any PPE. The workers also appeared to be experiencing problem from the heat as they repetitively dabbed their sweat away.

Chemical Colour Mixing Area

In this area plastic spoons were used to retrieve the powdered chemicals (sodium carbonate, Alumunium Potassium Sulfate, Reactive Orange 16, Reactive Blue 19, Reactive Red 120) for the dyeing process. The worker wore a fabric mask over his mouth and sandals on his feet, but no other PPE was evident. Electric cables were observed hanging near vessels containing chemicals.

Batik Tulis Drawing Area in the Village

Additional observation was carried out in a local village house as the Batik tulis (which is bought by the company from the villagers) was being created (this is traditionally created by women).



Figure 5. Sun-Drying Area

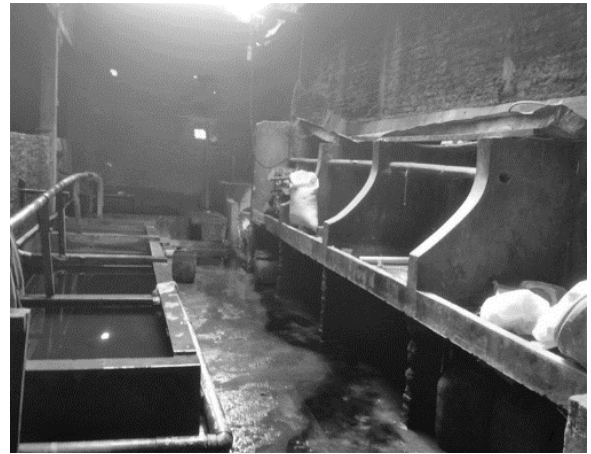


Figure 6. Dyeing Area



Figure 7. Printing Area



Figure 9. The Chemical Used



Figure 8. Chemical Color Mixing Area



Figure 10. A Village Woman was Making 'Batik Tulis'

Table 1. Risk Assessment

Workplace Area	Hazards Present	Likelihood	Severity	Risk	Effects	Existing Control
Heat stress	Heat stress	5	1	5 (low risk)	Limited concentration, cramps in the muscle, heat rash, thirst, fainting, heat exhaustion, heat stroke (HSE, 2016)	None
	Ergonomic	5	1	5 (low risk)	Musculoskeletal Disorder	Trolley
	Hand-pinched	4	2	8 (low risk)	Small Cut	None
Dyeing	Mechanical	5	3	15 (high)	Slips, trips, falls	Mopping the floor
	Biological	5	1	5 (low)	Skin problems because of humid conditions (for example ringworm)	none
	Ergonomic	5	3	15 (high)	Musculoskeletal Disorder	none
	Sodium Carbonate (Soda Ash)	5	3	15 (high)	Cough, sore throat, redness in contact with skin, eye pain and redness, and burning sensation in the throat and chest when ingested.	Occasionally staff use a mask made from thin fabric
	Tawas (Aluminum Potassium Sulfate)	5	3	15 (high)	Skin, respiratory track, eyes, and digestive track irritation	Occasionally staff use a mask made from thin fabric
	Reactive Orange 16	5	3	15 (high)	Sensitisation, irritation to the eyes, respiratory system, and skin, fire and explosion if mixture with air, may emit poisonous and corrosive fumes (Santa Cruz Biotechnology, 2011)	none
	Reactive Blue 19	5	3	15 (high)	may cause irritation to the eyes, skin, digestive tract, and respiratory tract, an experimental carcinogen, may release irritating and highly toxic gases when on fire (National Center for Biotechnology Information, 2016)	none
	Reactive Red 120	5	3	15 (high)	may cause eye discomfort, conjunctivitis (prolonged and repeated exposure), may irritate the respiratory tract, associated with the development of bladder cancer, may emit toxic fumes when combusted and decompose (Santa Cruz Biotechnology, 2011)	none
Heat stress	5	1	5 (low)	Lack of concentration, muscle cramps, heat rash, severe thirst, fainting, heat exhaustion, heat stroke (HSE, 2016)		

Continued Table 1. Risk Assessment

Workplace Area	Hazards Present	Likelihood	Severity	Risk	Effects	Existing Control
Printing	Heat Stress	5	1	5 (low)	Limited concentration, cramps in the muscle, heat rash, severe thirst, fainting, heat exhaustion, heat stroke (HSE, 2016)	none
	Sodium Carbonate (Soda Ash)	5	3	15 (high)	Sore and burning sensation in the throat, a cough, problems in the eye involving pain and redness, skin problem, and burning sensation in the chest when ingested	Occasionally staff use a mask made from thin fabric
	Tawas (Aluminium Potassium Sulfate)	5	3	15 (high)	Irritation to the skin, eyes, digestive track, and respiratory tract	Occasionally staff use a mask made from thin fabric
	Reactive Orange 16	5	3	15 (high)	Problems in the eyes including sensitization and irritation, problems in the respiratory system and skin. When in contact with the air, fire and explosion might occur. Furthermore, poisonous and corrosive fumes might resulted as well. (Santa Cruz Biotechnology, 2011)	none
	Reactive Blue 19	5	3	15 (high)	Problems in the skin, eyes, digestive track, and respiratory system such as irritation might occur. Highly toxic gases if fire occurs (National Center for Biotechnology Information, 2016)	none
	Reactive Red 120	5	3	15 (high)	Eye discomfort might occurIf exposed repeatedly over a prolonged period, conjunctivitis might occur. The respiratory tract might be affected as well. The substance is associated with bladder cancer. The substance might release toxic fumes when combusted and decayed (Santa Cruz Biotechnology, 2011).	none
	Disorganized Area	5	3	15 (high)	Slips, trips, falls	none
	The gas-fueled drying machine	5	2	10 (medium)	Burned skin	none

Continued Table 1. Risk Assessment

Workplace Area	Hazards Present	Likelihood	Severity	Risk	Effects	Existing Control
Chemical Color Mixing	Sodium Carbonate (Soda Ash)	5	3	15 (high)	Burning sensation and sore in the throat, cough, skin problems, pain and redness in the eye, and burning	Thin fabric masks are occasionally worn by the staff
	Tawas (Alumunium Potassium Sulfate)	5	3	15 (high)	Potential irritation to the eyes, skin, digestive, and respiratory tract	Thin fabric masks are occasionally worn by the staff
	Reactive Orange 16	5	3	15 (high)	May irritate and sensitize the eyes, skin, and the respiratory system. Fire and explosion might occur if in contact with air. Poisonous and corrosive fumes might resulted (Santa Cruz Biotechnology, 2011).	none
	Reactive Blue 19	5	3	15 (high)	Eye,skin, digestive, and respiratory tract irritation might occur. Toxic gases occur when combusted (National Center for Biotechnology Information, 2016)	none
	Reactive Red 120	5	3	15 (high)	Eye discomfort might occur.If exposed repeatedly on prolonged period, conjunctivitis might occur. Respiratory problems can occur and the substance is associated with the risk of bladder cancer. Toxic fumes occur when combusted and decayed (Santa Cruz Biotechnology, 2011)	none
	Cable of Electronic Mixer	5	3	15 (high)	Electric shock	none
Batik Tulis	Ergonomic	5	3	15 (high)	Musculoskeletal Disorders	none
	The hot wax fumes	5	2	10 (medium)	Eyes and respiratory system may get irritated (Soebaryo and Budianti, 2020)	none
	The hot wax and hot tools	5	2	10 (medium)	The hot wax and hot tools may cause skin burns ' skin	none
	Disorganized Area	5	3	15 (high)	Slips, Trips, Falls	none

At the village house, wax was melted on a domestic stove and was used to draw the patterns. It was observed that the ‘dingklik’, a traditional chair which has no backrest and armrest was used for sitting. The working process required the woman creating the Batik tulis to twist and bend her body, stretch her arms and hands, and sit in prolonged, static, and awkward position.

Interview Results

Six workers, each with responsibility for a different area of the site were chosen for interview. All of the interviewees were male and had long experience in their job role. Interviews were carried out to better understand risks from the workers perspective.

There were varying responses from the workers, with respect to the perception of risk as follows:

“ I think the chemicals are not dangerous.” (worker 4).

“ I use the fabric mask because the substance is harmful”(worker 1).

Some health problems were reported by the workers, including skin problems (itchiness and redness), respiratory issues (cough), stiffness, fatigue, headache, tiredness and weariness:

“ I feel fatigue and tired at the end of the shift because I must ensure that the colour liquid absorb in them. The process must be conducted 25-30 times.” (worker 2)

“The skin problems will disappear after a while s. I think we have some kind of adaptation to it.” (worker 3).

“ I feel dizziness occasionally so I drink plenty of milk to improve my condition...”(worker 3)

There were comments about the housekeeping and maintenance in the factory:

“The trolley is not used because of the rust present and it just disturbs my work.” (worker 4)

“I have 20 years working experience. My former workstation was neater than this. This upsets me.” (worker 5).

The workers reported the high staff turnover which could affect productivity and suggested the need for more support:

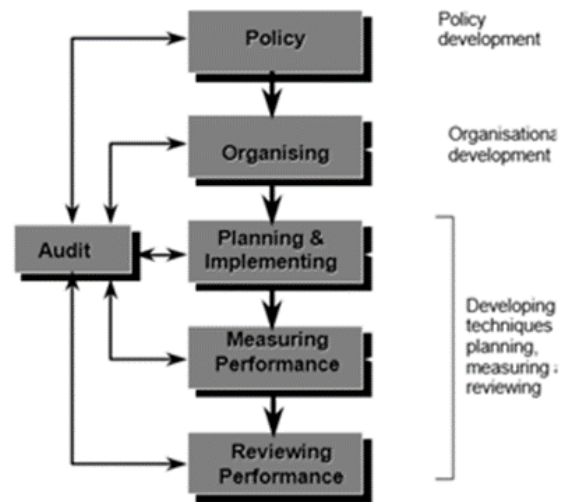
“...After developing some skin problems, the majority of the new recruits will quit after a month or so.” (worker 6).

“I will use the over counter medicine when I feel sick. The company does not provide the medical costs.”(worker 1).

DISCUSSION

One of the emerging findings from this study is around the lack of available information regarding the risks associated with the production of Batik. This corresponds with a previous studies by Susilowati (2014), Anis *et al*, (2013) and Afriansyah (2013) who found that workers in Batik are lacking safety information all of which contributes to safety perception and attitudes

This study also found chemical, physical, biological, ergonomic and mechanical hazards present in the Batik factory. The findings correspond with those of Sari (2014) who found well over 100 occupational hazards (2015). John *et al.*, (2020)



Source: Health and Safety Executive

Figure 11. .HSE Model (HSG65)

reported sources of health hazards corresponding to this study including ergonomic issues, lack of lighting, concern related to room temperature, as well as humidity affecting ears, nose, skin, and throat (John *et al.*, 2020). Agustina, Maulana and Trunojoyo, (2012) also reported the effect of the heat, ergonomic issues and the impact of harmful chemicals.

There are several other studies that correspond with the reported findings of this study, including Soebaryo (2012) who found that from their study that 18.2% of batik workers develop dermatitis. Perdana (2013) found that 75% batik workers reported pain in their necks, 10% reported back problems, 5% reported problems with their hips, and 10% with problems elsewhere in the body.

Workers interviewed in this study reported a high turnover of staff, with health issues such as dermatitis being a determinant around this. Bayram, Ünğan and Ardiç (2017) discuss how expensive this turnover is to a business due to the fee implications of replacing staff, productivity loss, workplace health and safety problems as well as morale damage. A study by Mabindisa, 2013 also found that high level of staff turnover affect the companies' image (Mabindisa, 2013).

Health and Safety Management systems have been shown to be effective in reducing the number of accidents in the workplace and have also been linked to more positivity amongst the workforce and evidence is presented in studies by Yoon *et al* (2013) and Day and Nielson (2017) corresponding with this. The POPMAR Model (HSG65), shown in Figure 11 below has been shown to have benefits in

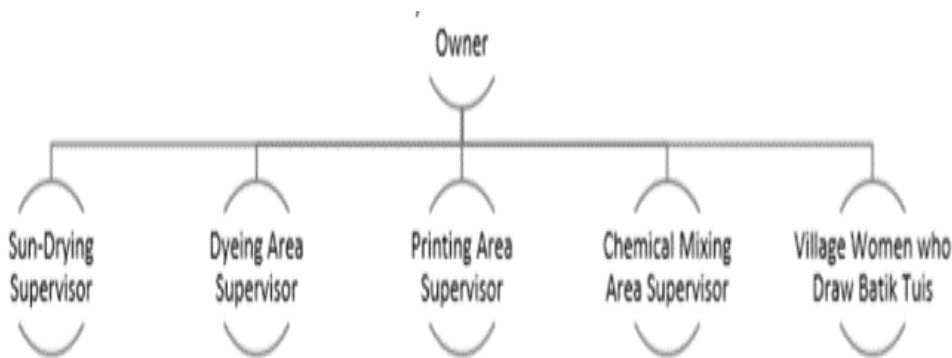


Figure 12. The Company Management

this respect. (Yoon *et al.*, 2013) (Buica *et al.*, 2017) (Yiu *et al.*, 2019).

Each area of the POPMAR model discussed in more detail against the research findings is below:

Policy

According to the Health and Safety Executive (2013) it is fundamental for a company to develop a health and safety policy because it sets the clear goal and direction for improved outcomes. Importantly, this model advocates for the director of the company sign off the written policies. Osbourne and Hammond (2017) underpin the importance of this as well as the visibility of these policies in the workplace.

Organizing

Having clear management arrangements and structures has been shown to contribute to effective communication and improve workers' engagement and participation with health and safety (Walden, Jung and Westerman, 2017; Osborne and Hammoud, 2017). The Health and Safety Executive (2013) state that "the actions in the 'Organizing' stage are divided into methods of control in the organisation, the co-operation between stakeholders, the communication method in the organisation, and the individual's competence". For the Batik company studied, the organizational structure in existence would benefit with communication and dissemination of information by having a supervisor in each area (other than for the village women).

However, as well as good communication routes, appropriate 'competence' must also be ensured to guarantee that the workers have the adequate capabilities to understand and relay health and safety messages.

From the interviews, it was evident that staff acquired their skills from their prior profession but

there appeared to be less awareness around health and safety issues. For example, there was some knowledge that the chemical substances might be harmful to their skin but were unclear on how to protect themselves against this.

Planning and Implementation

The Health and Safety Executive (2013) states that this stage is thinking about the goals and considering how practically we might achieve them. This involves consideration of appropriate action controls, including importantly conducting a risk assessment. This can be linked to the ALARP (As Low as Reasonably Practicable) principle which sets out to put in place the best controls as far as practical to reduce the risk, carefully considering cost-benefit of different approaches.

As part of the planning and implementing stage of POPMAR, the process of documenting the findings is a significant step. By recording, inspecting, monitoring, and maintaining good records of hazards and risks, the company can show an auditable trail which helps with show compliance with the regulations, as well as creating good corporate responsibility and a caring outlook.

Measuring and Reviewing Performance

The final stage of the POPMAR model is to ensure that the actions proposed are being implemented. The company must measure their performance against the actions taken. (HSE UK, 2013). Ismail and Measures (2020) mention that work processes must be measured and evaluated to know their impact. Burdyny and Smith (2019) refer to this process creating a better designed working environment. Companies carrying out such evaluation are linked to an organizational climate for innovation (Shanker *et al.*, 2017)

CONCLUSION

In this study, we found, through observation that there were chemical, biological, physical (including ergonomic) and mechanical hazards, with varying levels of control and management in place. The workers in the had limited information about the existing health and safety issues and in some cases were unaware of the risks. Some workers had experienced health problems related to the tasks they were undertaking.

Many of the issues highlighted can be addressed by a good understanding of the risks involved, together with an in-depth risk assessment, utilizing the POPMAR model to frame the activities. This creates a positive path that can lead to a continuous cycle of improvement and puts the workers' health at the forefront of the activities.

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