Revitalisation Strategies for Indonesian Stitch-resist Dyeing

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The candidate confirms that the work submitted is her own, except where work which has formed part of jointly-authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below. As the main author, I prepared the first draft for the manuscripts below and then the co-authors gave editorial advice. The candidate confirms that appropriate credit has been given within the thesis where reference has been made to the work of others.

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For my late father and my mother

who inspired and made this journey possible.

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Abstract

The textile-making custom in Indonesia has produced a myriad of outstanding cloths. One of the traditional Indonesian techniques is stitch-resist dyeing which has been practised in different regions. The commercialisation of craft goods, through the effects of globalisation, has transformed how Indonesian craft makers practice the stitch-resist dyeing technique over the past decades. The craft makers also face the challenge of producing high uniformity of cloths in significant numbers, in the aftermath of the Indonesian government policy of encouraging the use of traditional textiles as corporate wear. This study aims to analyse the commercialisation effects on the stitch-resist dyeing practice in order to formulate appropriate revitalisation strategies for sustaining the tradition. This mixed-method research was carried out by collecting primary data from a survey in three of the textile-making locations (Palembang, Banjarmasin, and Yogyakarta) and laboratory experimentation, alongside analysing relevant secondary data.

Overall, there are three consequences from commercialisation in the Indonesian stitch-resist dyeing practices: (i) a transformation of cloth design, by simplifying the design or adopting other techniques; (ii) an inconsistent and poor quality pattern, driven by market needs; (iii) a low craft makers' welfare in terms of their income level and workshop facilities. The increasing market and production level were not supported by upgraded facilities, which could harm the ecology in the long term. This study argues that stitch-resist dyeing practices require appropriate technology and organisation for sustaining the culture, improving the pattern quality and innovation. Equipment on individual and communal level were suggested based on the experiment result. For the communal work, the practice is advised to utilise an advanced and eco-friendly technology in a co-working space operated by a worker cooperative. The implementation of suggested revitalisation strategies can be incremental and partial, according to the craft makers' capabilities.

Keywords: stitch-resist dyeing, Indonesian cloths, commercialisation of craft, appropriate technology and organisation, cooperative.

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Chapter 1
Introduction

This chapter maps the landscape of this study, explaining several principal points as the contexts of this research. This introduction chapter is structured in four sections that begin with a research background in section 1.1. This section is then followed by section 1.2 which elaborates the problem contexts on the specific issues relating to this research topic, the necessity and opportunity for applying an appropriate technology and appropriate organisation on stitch-resist dyeing as a revitalisation strategy. The following section (1.3) presents the research aims, research objectives and research questions. Lastly, section 1.4 describes the outline of this thesis. The subsequent chapter is a discussion of selected published literature.

1.1 The research background

Indonesia is one of the biggest archipelagos in the world that has a diverse culture. Indonesia has more than three hundred tribal and ethnic groups speaking two hundred languages coexisting within its boundaries (Warming and Gaworski, 1981, p.11). The major religions of Islam, Christianity, Buddhism, and Hinduism are represented in Indonesia, but some of the remote peoples still adhere to animistic beliefs. Some tribes live in villages of only a few houses; while some people lead an early twenty-first century lifestyle in the metropolitan cities, such as Jakarta (Warming and Gaworski, 1981, p.11). This diversity is reflected in the arts and crafts area, in particular, the variety of traditional cloths. Each ethnic group produces different traditional cloth with a variety of methods. Resist-dyeing, weaving and embroidery are three categories of well-known textile techniques from Indonesia (Hitchcock, 1991). This section aims to describe the nature of craft in Indonesia in general and later specifically in the textile custom.

1.1.1 Indonesian craft (*kriya*)

This section aims to explain the craft practice in Indonesia in comparison to craft from the Western perspective. In English, the word ‘craft’ can be used as a noun and means an object produced involving a hand skill, and as a verb, it means to make or produce something (an object) skilfully, typically by hand (Macmillan, 2019; Oxford, 2019). When it forms in plural, crafts mean work or objects made by hand (Oxford, 2019). It implies that craft is defined as manual process or handwork, or anything that results from it.

The craft practice in Indonesia is related to handwork process. The rise of craft in Indonesia was related to the historical background of Indonesian culture. South Sumatra was a gathering place for merchants and emissaries, especially during the Sriwijaya kingdom (seventh - eleventh century) (Vlekke, 1959; Barnes, 2010). Those migrations brought Hinduism, Buddhism and Islam to Indonesia over the next centuries (Hitchcock, 1991; Barnes, 2010), which also influenced the Indonesian craft culture. Two kingdoms that related to craft, particularly to the textile customs, were the Majapahit kingdom (thirteenth-fifteenth century), and the Mataram sultanate (sixteenth – eighteenth century) (Vlekke, 1959; Taylor, 2003). Both kingdoms later became the precursor of Yogyakarta sultanate (eighteenth century - present) and Surakarta sultanate (eighteenth century - present) (Vlekke, 1959).

One of the heritages from that kingdom’s period, especially the sultanates’ period in Java, was a classification between *budaya Agung* (great or high culture) which was a culture that flourished inside the palace, and *budaya Alit* (small or low culture) which referred to a culture outside the palace (Triharini, 2014, p.48). From those cultures, two types of Indonesian traditional crafts were later formed as *kriya* (also written *kria*) and *kerajinan* (Krisnanto, 2009 in Triharini, 2014). Originating from inside the palace, *kriya* was appraised as the precious one – or called *kriya adiluhung* – as it reflected the uniqueness, beauty, and greatness of the culture which contained aesthetic values, symbolic values, philosophical values, yet were still functional (Triharini, 2014). This kind of craft required a special artist who had excellent hand skills with spiritual ability. Making *keris* is a good example of *kriya adiluhung* which was started by carefully selecting material through a mystical process. *Keris* is the Javanese traditional asymmetrical dagger made of mixed iron, nickel, and steel that represented the philosophical values of the culture of the period (Triharini, 2014).

On the other hand, *kerajinan* is developed outside the palace to fulfil the needs of the common people. Products of *kerajinan* are usually recognised as low-quality with less, sometimes no, aesthetic sense compared to *kriya* (e.g. hoes, cleavers, bamboo baskets, and pottery) (Triharini, 2014). The term *kerajinan* presumably was established during the Dutch colonisation in Indonesia (around 1800-1950) because the term does not appear in the old Javanese repertoire (Triharini, 2014). The Dutch colonisation had caused a significant shifting of the cultural values that made *kriya* part of economic activity (Triharini, 2014). The Dutch established a type of enterprise that aimed to reproduce valuable artworks. The enterprise was called *kunstnijverheid* in Dutch, which was assumed as the origin of the word *kerajinan. Kerajinan* was derived from the word, *rajin* (an adjective), with the prefix *ke-* and suffix *-an*, meaning diligent (Triharini, 2014). *Kunstnijverheid* means applied art or craft, but also contained the word *nijver*, meaning diligent. So presumably, the Indonesian people translated the *nijverheid* as *kerajinan*, since the word *kerajinan* did not appear in the repertoire of old Javanese language (Triharini, 2014).

In contrast, craft in a western perspective was classified based on their elements of the ideological and intellectual underpinning of the craft constituency; those elements were described as decorative art, the vernacular and the politics of work (Greenhalgh, 1997). The first type of craft was an element of decorative art producing highly artistic artefacts, but it was not recognised in the art category by the classification system at that time. Differing from the first one, the vernacular craft was defined as the cultural products of a community. The emphasis was on the collective idea of a social group without any influence from outside. The last element of craft, the politics of work, was based on a whole vision of a better society through the need of engaging in creative work. It would improve the environment, lead to an equitable system of the distribution of wealth and generate psychologically fulfilled people. Work determines whether a community would live prosperously, as long as people are employed humanely and creatively. This vision was strongly believed by William Morris, Ruskin and Karl Marx (Greenhalgh, 1997).

All three elements (decorative art, the vernacular and the politics of work) were pulled together in a particular ideological climate throughout time, which has shifted the classification system into art – craft – design (Greenhalgh, 1997). The decorative art was closer toward fine art, the vernacular craft was more related to craft, and the last one became known

as design. In the twentieth century, design was identical with industry, and designers were clearly distinguished from artists and craftspeople. Craft is also defined as the antithesis to industrialisation with the notion that everything was crafted before industrialisation (Reubens, 2016). This classification system is still commonly used worldwide until now, but it also has been slightly merged to one another, creating an interdisciplinary area.

Alfoldy (2007) classified craft into three main groups: (i) traditional (conventional), (ii) contemporary and (iii) modern. Traditional crafts have a strong relationship with the multicultural history of certain societies, which was indicated in the craft forms, artefacts and practices (Alfoldy, 2007; Holroyd et al., 2017). Meanwhile, contemporary and modern crafts are more influenced by art and design – a combination of aesthetics, individuality, function, technology but at the same time also maintaining the political badge of handmade (Harrod, 1997 in Chudsari, 2011; Alfoldy, 2007). Contemporary crafts have also started to appear in Indonesia recently, approximately since the government began to encourage designers and artists to be involved in traditional crafts (Triharini, 2014). This phenomenon is discussed in the following section as one of the problem contexts in this research. The similar history and characteristics of Indonesian craft is also manifested in the Indonesian textile custom. The next section discusses the background in Indonesian textile custom from traditional until present.

1.1.2 The textile custom in Indonesia

The pattern and technique of textile customs in Indonesia have been acculturated by various waves of migrations and by outside cultural influences (Warming and Gaworski, 1981, p.12). As It was mentioned before, the traditions in Indonesia mostly have been influenced by religious dogmas from Hinduism, Buddhism, Islam, and more recently from Christianity (Hitchcock, 1991). The assimilation of Indonesian customs evolved through traders and pilgrims mainly from Asian and European countries who brought their own cultures to Indonesia. Hitchcock (1991) identified that the Indonesian textile design and technology aspects have strong links to the Asian mainland, such as the use of body-tension looms or Chinese phoenix patterns in *batik*. The Indian culture had been a strong influence to many Indonesian's textile customs throughout trading activities since the seventh century (Maxwell, 2003). One of examples was an

adaptation of a silk woven *patola* pattern from Gujarat, India into *batik jelamprang* pattern in Java (Gillow, 1995; Doelah, 2002; Hann, 2005).

The demographic and geographical aspects of Indonesia create diversity in ethnicity and custom related to textile production. Each ethnic group has its own textile heritages (Forshee, 2006); thus, Indonesia has significantly different types of traditional cloths. Three primary techniques in Indonesia, as it was mentioned by Hitchcock (1991), are weaving, resist-dyeing, and embroidery. All methods are utilised in thirty-three traditional cloths that were claimed as a cultural heritage of Indonesia by the Indonesian Ministry of Culture and Education (Indra, 2017). This recognition by the Indonesian government aims to build awareness and encourage Indonesian people to be involved more in the cultural preservation programme, especially in the traditional cloths (UURI, 2010). Although the criteria for selecting the traditional cloths was not described, the list can represent the spread of techniques among the Indonesian traditional cloths. From the list of Indonesian traditional cloths, the weaving technique is the most widely used (Indra, 2017). The woven cloths have become almost synonymous with the Indonesian identity (Gillow, 1995). The embroidery technique is the second most utilised technique, followed by the resist-dyeing technique, which includes *batik* and the stitch-resist dyeing technique (Indra, 2017).

Figure 1.1 *Hinggi Kombu*: a man's cloth made by warp *ikat* technique from east Sumba, Indonesia (Maxwell, 2003, p.18)

Resist-dyeing technique is one of the textile methods which an iterative process of covering some areas before the dyeing process to create patterns. In Indonesia, this technique has three variations of resist method, which relate to some traditional cloths. Firstly, an application of hot wax on woven cloth as the resisting method produces *batik* cloth, the most well-

known textile from Indonesia (Hitchcock, 1991; Gillow, 1995; Doelah, 2002). Secondly, a process of tying and sewing some thread on woven cloth, relates to *jumputan* cloth and *tritik* cloth (Ikle, 1941). The last method is tying some areas on woven threads, then dyeing the knotted thread before putting them on a weaving loom (Maxwell, 2003; Heringa, 2010). This method is known as *ikat*, and even though it applies a resist-dyeing technique, this method is more associated with weaving technique (Figure 1.1). Woven cloths in Indonesia are considered as one of highly diverse and complex designs in the world (Forshee, 2006). However, champions of some other cultural design traditions may challenge this apposition which is understood. One of the examples is a highly intricate double-*ikat* woven. Double-*ikat* technique is a pattern resisted process which applied on both weft and warp thread before the weaving process, and it requires high precision for the pattern to appear clearly (Hitchcock, 1991). Indonesia is renowned for the double-*ikat gerinsing* cloth from Bali (Figure 1.2). A similar double-*ikat* technique is also produced into renowned silk double-*ikat* cloths in India, namely *patola* cloth in Gujarat and *banha* cloth in Orissa (Hann, 2004; Weiss, 2014). This resemblance can be linked to the strong influence of Indian culture during the trading activities around the seventh century (Maxwell, 2003).

Figure 1.2 *Gerinsing wayang kebo* cloth, a double *ikat* cloth from Tenganan, Bali (Maxwell, 2003, p.149)

The Indonesian traditional textiles are captivating not only for the richness of their patterns but for the meaning they often have in their society (Warming and Gaworski, 1981). Textiles play an integral role in many Indonesian societies and also represent the material culture, as physical artefacts, processes, individual expression, tradition, economic activities, technological development, community structure, and also repositories of wealth and value (Warming and Gaworski, 1981; Gale and Ordoñez, 2004). The role of each textile must be viewed in the context of the makers' culture and the forces

that shaped their lives (Warming and Gaworski, 1981, p.12). All these points are the fundamental concerns in conducting this study.

Throughout Indonesia, there were strict rules that specified which textile patterns were associated with every level of society. *Batik* technique flourished in three main *batik* regions in Java area which are Central Java, South-west Java and the North Coast (Hitchcock, 1991, p.92). Each area has its own pattern characteristic. *Batik* from Central Java grown alongside the high culture of the old Yogyakarta sultanate and Surakarta sultanate (Hitchcock, 1991), they are renowned as *Batik Keraton*. Initially, those *batik cloths* were exclusively made inside the palace only for the member of royal family (Doelah, 2002). The *batik* process then was expanded into outside the palace to fulfil the increasing demand for the royals (Doelah, 2002). This situation had led to the courts decreed the commoners from wearing specific patterns, especially in around eighteenth century (Hitchcock, 1991; Doelah, 2002).

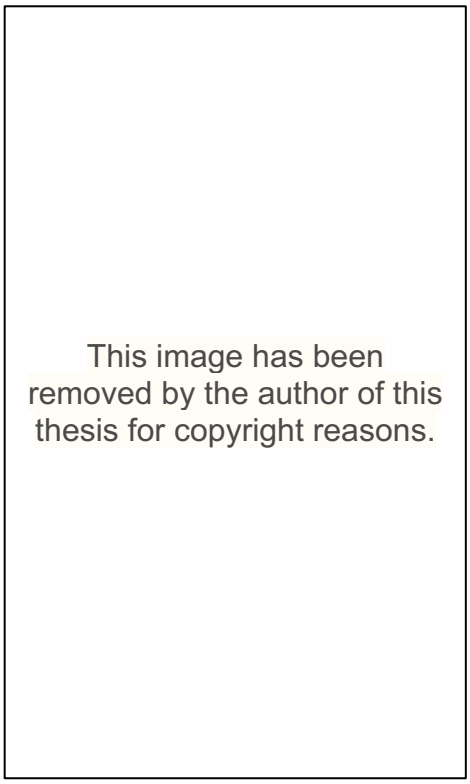


Figure 1.3 Image of restricted *batik* pattern wore by the Yogyakarta royal family.

Description: Prince and Princess Pakualam of the Yogyakarta royal family in 1920 are wearing *parang rusak* pattern on their *batik* waist-cloths, *kain*, which was restricted to members of courts (Hitchcock, 1991, p.170)

Some traditional *batik* patterns such as *parang rusak, sawat, sembangen,* are only allowed to be worn by member of sultanate families (Figure 1.3) in specific occasions (i.e. going to war, giving birth, and getting married) (Hitchcock, 1991; Doelah, 2002). For example, the *jelamprang* pattern later was reserved exclusively by the Sultan of Surakarta family in 1769 (Gillow, 1995). The sultans of Central Java would periodically lay down stringent penalties for transgressions of these sumptuary rules (Gillow, 1995), the last revision in the Yogyakarta court of the sumptuary laws listing the patterns restricted was in 1927 (Heringa, 2010). Some restriction *batik* pattern rules are still applicable for people inside the palace only; not for common people (Dalem, 2018).

Similarly, Sumban society, people who live in the Sumba island, also used to apply similar rules by the kings of Sumba until the 1920s (Gillow, 1995). Slaves dressed in plain-coloured waistcloths, whereas the king wore a multi-coloured warp-*ikat* woven mantle, adorned with the special symbols of power and mystical significance reserved for royalty (Gillow, 1995). This unwritten rule has a similar concept with the distinction of *budaya Agung* (high culture) and *budaya Alit* (low culture) that was explained in section 1.1.1. The plain colour of small waistcloths represented the basic craft product that is less ornamental, only functional. Over time, these rules faded and erased the hierarchy. Anyone is now allowed to utilise and explore the strictly ruled *batik* pattern into an everyday design.

In several locations, the traditional textile was used to be part of their cultural ceremonies, mostly related to their beliefs. The ancient belief system, describe by Hout (2010) as cosmic dualism, is the foundation of Indonesian culture. The belief divided the universe into two orders that were opposite but also complementary, such as male and female; sun and moon; head-hunting and weaving; and metal and textiles. Traditionally, textiles played a vital role in maintaining harmony and balance between spirits and humanity. Textiles were used as attributes for agricultural and life-cycle rituals, such as birth, puberty, marriage, and death that involved gift exchanges representing of the male and female part of the universe (Hout, 2010). Gifts from males' sides were usually any types of weapon, while gifts from the females' side would consist of textiles (Gillow, 1995). The textile production method and the pattern knowledge were traditionally passed from mother to her daughter. Thus, textile activities were associated with female works, and some of these concepts stay in modern Indonesian society. Although, this

custom of using textiles as part of the ceremonies has currently waned and become a commodity in modern cities.

Historically, the trade of Indonesian traditional cloths started when the Dutch East Indian company collapsed at the end of the eighteenth century after an economic crisis (Gillow, 1995). As a consequence, in the nineteenth century the Dutch expanded their trade in foreign cloths and Javanese *batik*, penetrating the whole archipelago with these cloths (Gillow, 1995). The increased volume of trade at that time had several far-reaching consequences. That phenomenon leads to the adoption of *cap* process, a wax copper block printing process, into the *batik* industry during the late of nineteenth century (Hitchcock, 1991; Gillow, 1995). The *cap* tool would quicken and increase production in comparison to the use of the original hand writing tool, *canting* (Hitchcock, 1991). The other consequence was an initial expansion of cotton growing in Java and local production of the finely woven cloth that *batik* requires. Although not long after that, the Javanese cotton industry faced challenges from cheap imported textiles from Europe, Egypt, India and Japan (Gillow, 1995). However, some factories in Java are still producing woven cambrics for *batik* and other Indonesian traditional cloths, which come in four grades – *primissima* (the finest), *prima, biru,* and *merah* (the coarsest) (Hitchcock, 1991). The invention of *cap* process is recognised as an important point that diversified the *batik* process into mass production without replacing the high culture of the handwritten *batik* process. Even now, the combination of both methods has opened up an exploration of the *batik* process in producing contemporary yet traditional *batik* cloths.

Batik cloth was popular during the Dutch colonisation (Gillow, 1995), and remains so. It gained a stronger reputation after recognition from UNESCO on the 2nd of October 2009, as Indonesian cultural heritage with the most difficult techniques to make a pattern in cloth manually (UNESCO, 2009). That day was later declared as National *Batik* day. This moment certainly has given a positive impact to the *batik* state of affairs, and the support system has centred around *batik* production. Until early twenty first century, the *batik* technique has penetrated every region, producing different styles based on their area. This circumstance of *batik* gives some good influences on other traditional cloths, such as increasing awareness of Indonesian textiles which lead to higher demand. On the flip side, the popularity of *batik* cloth overshadows other traditional cloths. It makes the other traditional

cloths difficult to distinguish by common people, especially between similar resist-dyed cloths.

Figure 1.4 Two examples of group photos showing corporate wears made from *sasirangan* cloths in Indonesia.

Description: Both images show *sasirangan* cloths made by Cempaka *sasirangan* for (above) Kalimantan Selatan Bank corporate wears in South Kalimantan, 2018; and (below) for Banjarbaru Protocol Department staffs in South Kalimantan, 2019. Images were provided by Cempaka *sasirangan* from their documentations (May 2020).

The development of Indonesian traditional textiles is very closely related to the growth of fashion in the past decade. The basic use of the traditional cloths in Indonesia is as a garment. Since Indonesia has a tropical climate, clothing requirements are relatively modest. The garments are simple, traditionally composed just of unsewn rectangular cloth in three metre lengths (Forshee, 2006, p.142). Back in time, there were four main types of cloths as garments, which are (i) *kain*, which wraps around the waist and legs; (ii) *sarongs*; made of a smaller *kain* sewn into a tube-shape; (iii) *selendang*, breast and shoulder cloths; and (iv) *selimut*; large wrap-around mantles of blankets (Gillow, 1995). Figure 1.3 shows an example how the traditional cloths were worn as a *kain* by the royal family in the early twentieth century.

After being independent from colonisation for almost seventy-five years, Indonesia is changing fast and has grown into a modern developing country. Although the modernisation has not spread to the whole country, some big cities have shown different lifestyles from the previous time. In some big cities, people preferably wear contemporary and factory-made clothing, reflecting a slightly conservative Western style (Forshee, 2006). Many Indonesian people of the present-day keep tradition by dressing in combinations of new and old ways: selectively modern while retaining essentials of their homeland customs (Forshee, 2006). Many fashion designers are involved in preserving the textile custom by designing fashion products with traditional cloth. The design in traditional dress has changed, which reflects individual choices in aesthetics and lifestyles as time changes.

Several initiatives from the Indonesian government has been contributed to the latest condition of the traditional textile. Some policies have been implemented to encourage Indonesian people to use more traditional fabrics in their daily activities. For example, every government employee is supposed to wear clothes made of traditional cloths every Thursday and Friday effectively started since 2007 (PERMENDAGRI, 2016); this policy is latterly followed by the private company employee too. Some examples of corporate wears made from traditional cloths are provided in Figure 1.4. This situation has provided a bigger local (or even international) market for the Indonesian traditional textiles and shaped the latest textile custom, including the stitch resist-dyeing practices. The majority of traditional textiles in Indonesia starts transforming from the production of these textiles at home onto a workshop level with many of the processes involved are still both time-consuming and labour-intensive. As a pitfall, some artistry or skill could

potentially lose when the textile production is increasingly commodified (Scrase, 2003: p. 452). Furthermore, this commercialisation and globalisation phenomena could also lead an artisan into a hybrid identity, where the artisan retains traditionalism in their craft while simultaneously providing goods for a global consumer or local tourist market (Scrase, 2003: p. 459).

1.2 The problem contexts

This section discusses several issues as the context of this study. The discussion begins by stating the importance of preserving and revitalising the tradition of stitch-resist dyeing technique and continues by discussing the current state of Indonesian textile craft products after commercialisation that is mostly driven by the economy strengthening and women empowerment. This is followed by an examination of several revitalisation studies on traditional craft practices that have been conducted using design approaches with different perspectives. Finally, the discussion examines the necessity and possibility of formulating an appropriate technology and organisation for a revitalisation framework of traditional textile technique.

1.2.1 The importance of stitch-resist dyeing technique to be preserved and revitalised

This study focuses on one of the Indonesian resist-dyeing techniques, which is stitch-resist dyeing technique. The technique is a traditional craft practice that is part of the culture of different ethnic groups in several locations in Indonesia. Up until now, the documentation about the stitch-resist dyeing technique is considered low compared to other traditional textiles. Some groups of ethnic people employ this technique to produce their authentic traditional cloths that related to ceremonial purposes (Hitchcock, 1991; Seman, 2008; Waterson, 2010). Some of those cloths are namely *tritik* or *kembangan* cloths in East Java, *paritutu roto* cloth in South Sulawesi, *sasirangan* cloth in South Kalimantan, and *pelangi* cloth in South Sumatra (Hitchcock, 1991; Seman, 2008; Waterson, 2010). Latterly, the technique has been utilised as an economic tool by some communities, to manufacture stitch-resist dyed cloths as a commodity.

The study of stitch-resist dyeing origin is interrelated with the tie-dyeing technique in general. The stitch-resist dyeing technique, or known as *tritik*, has been considered as a variation of tie-dyeing technique, a process that consists of protecting parts of the cloth by tying them up so that those areas are reserved and the dye cannot fully penetrate under the ties (Robinson, 1969). This study argues that the stitch-resist dyeing as an individual technique has a latent quality that is not discovered thoroughly yet. This form of resist dyeing technique enables the designs to produce more intricate forms with a relatively simple technique (Robinson, 1969, p.78). Stitch-resist dyeing, as a particular form of resist-dyeing technique, is a textile technique that produces an authentic blurry pattern with multicolour and shade gradation (Seiler-Baldinger, 1994). A simple illustration of three important steps of stitch-resist dyeing technique is shown in Figure 1.5.

(a) (b) (c)

Figure 1.5 Three important steps of stitch-resist dyeing process (Larsen et al., 1976, p.16).

a. Stitching the thread into fabric.
b. Pulling and knotting the thread at the end.
c. Resultant pattern after the colouring process.

The stitch-resist dyeing technique has two critical processes, which are the resisting process and the colouring process. The resisting process in stitch-resist dyeing has three important steps; first, stitching the thread on the fabric; second, pulling the thread; and the last step, knotting the thread at the end (Larsen et al., 1976; Seiler-Baldinger, 1994), illustrated in (Figure 1.5a and b). This resultant resist area would produce the pattern after the colouring process (Figure 1.5c). Therefore, the steps of stitching, pulling and knotting the thread are considered as an important step in creating an

authentic pattern. At the same time, these parts are often done manually, which require craftsmanship skill and are generally recognized as being time-consuming for commercialisation purposes. The colouring part in stitch-resist dyeing process can be conducted with different methods and types of dyestuff; further explanation in section 2.6.

Stitch-resist dyeing technique offers great versatility and control (Singer and Spyrou, 1989) with more possibilities to obtain complex patterning and a wide variety of designs (Hann and Thomson, 1993). Some advanced design and technique explorations of stitch-resist dyeing technique had demonstrated the possibility of new artistic design that could be implied to the Indonesian stitch-resist dyeing makers under certain circumstances (Ellis, 2005; Wada et al., 2011; Titisari, 2012). The further explanation about those methods are described in section 2.8. Despite the potential of this technique, in Indonesia, the technique remains in the shadow of other dominant resist-dyeing technique. The close related process with *batik* made people misunderstood the stitch-resist dyeing technique to *batik* technique. It is expected that the development of this technique as an individual method is elevated from a comprehensive study of stitch-resist dyeing technique. More importantly, the development based on the craft makers culture and tradition would give a benefit back to the craft makers who employ this technique.

1.2.2 The commercialisation of Indonesian textile craft products for economy strengthening and woman empowerment

Society in a worldwide facing a challenge from modernisation that involves a shift towards consumer capitalism and industrialisation, as impacts of globalisation (Holroyd, 2018). While the transitions to modern society arise differently across countries, but the commercialisation of traditional craft products has occurred in South Asia and South-East Asia (Scrase, 2003; Chudasri et al., 2012; Holroyd et al., 2015; Chutia and Sarma, 2016). As society becomes modernised and industrialised, the ability of traditional craftspeople to continue working on the local scale is adversely affected (Holroyd et al., 2015). The craft practice needs to adapt to a new consumer society and is also challenged by mass-produced, standardised and cheap factory items which can replace craftsmanship (Holroyd et al., 2015; Holroyd, 2018).

At the same time, in a post-industrial era, the interest in traditional craft practice has increased, especially for Third World craft goods (Scrase, 2003; Holroyd, 2018). Many argue that the processes of modernisation and globalisation stimulate a desire for tradition, diversity and local distinctiveness (Holroyd, 2018, p.28). Scrase (2003) argued that this interest is related to the notion of western consumers ‘helping out' the struggling or marginalised crafts' people. The uncertainty and fragmentation from modernity characterisation have made society crave the sense of stability to individuals and societies, that can be offered by tradition (Holroyd, 2018, p.29). The last important points from globalisation are the emergence of the internet that connect the niche interest with the craft makers, bringing new life to traditional crafts (Holroyd, 2018, p.29).

Nevertheless, both impacts from the mass-production machine and the interest of traditional crafts have forced artisans to commercialise and intersect traditional manufacturing practices with techniques of mass production (Chutia and Sarma, 2016). The commercialisation and global expansion of certain traditional craft industries simultaneously can lead to economic, societal and cultural effects (Scrase, 2003). Furthermore, traditional craft practice is also facing a human resources problem as younger people migrate to urban centres for work and the attraction of modern lifestyles (Chudasri et al., 2012).

Those challenges also threaten the existence of Indonesian traditional craft. The craft practice in this context relates more to the activity of making *kerajinan* in Indonesia. As it was discussed in section 1.1.1, this type of craft in Indonesia was originated from the culture of common Indonesian, not the culture around a palace. *Kerajinan* has a role in fulfilling daily utensil needs and also provides jobs for some people, mostly women. The simple techniques of *kerajinan* are likely uncomplicated to master, and the works are easy to share with others. Therefore, *kerajinan* becomes an opportunity to create a good relationship between craftspeople which contributes to creating a harmonious life in a hamlet or village (Triharini, 2014). Making *kerajinan* tends to be an open activity of village people. The humid and hot climate of Indonesia makes people tend to do their activities by opening the door and windows, or even outside their house, to feel cooler. Therefore, craft activity is not considered as a personal activity to the Indonesian craft maker. The *kerajinan* product is usually created not for themselves, but for the market; thus it does not reflect the makers characteristic (Triharini, 2014).

Among the numerous handmade objects that considered as traditional *kerajinan*, only a few are able to compete economically against modern artefacts, such as the *batik* and other traditional textiles, jewellery, and rattan furniture (Triharini, 2014). Having said that, the Indonesian textiles craft practices are still facing similar challenges originating from the commercialisation and commodification of local culture. As it was explained in section 1.1.2, the traditional textile custom has waned in Indonesia, as modern Indonesian people are starting to wear simpler readymade garments. So the authentic traditional fabrics are only worn for any cultural and social events, namely marriage, pregnancy, death, and some art forms. The official government regulations of encouraging Indonesian employees to wear clothes made from traditional Indonesian fabrics every Thursday and Friday had affected the traditional textile practice (PERMENDAGRI, 2016). The majority of Indonesian people have started to use simpler patterns inspired by traditional textiles as garments on a daily basis and also as corporate wear on a weekly basis (Figure 1.4). This has created a new market for traditional textiles craft practices. This shift had a significant impact on keeping the traditional textile custom alive, including the stitch-resist dyeing crafts makers. Although, the new market of providing the corporate wear made from traditional cloth also creates a new challenge for the craft makers. The craft makers, in fact, now have to cope with a high demand to provide corporate wear made by the stitch-resist dyeing technique. Orders usually come in relatively large quantities compared to retail, and to a certain extent, needs to be uniform in design without losing authenticity. Facing these challenges and situation, in order to survive, lots of craft makers had initiated to develop the technique sporadically to be relevant for the contemporary needs. The modification aims to solve the problems at that time, means the solution is acceptable in the short term but not for the long term.

After Indonesia's declaration of independence, the traditional crafts are developed under the supervision of three offices in Indonesia: the Ministry of Cooperatives Small and Medium Enterprises, the Ministry of Trade and Industry, and the Creative Economy Board. The contribution of the craft sector into the Indonesia gross domestic product (GDP) is number three among other creative economy sectors (BEKRAF, 2018). The Indonesian government has attempted to promote traditional crafts as an economic commodity through the empowerment of micro and small-scale industry, especially for women. By orienting the development of traditional textiles

economically, the government pushes craftspeople to be able to produce textiles with better quality and in larger quantities. The craftsperson also has to keep developing his or her products, so that the market can accept it. This development of traditional textile is showing that the crafts are considered as the economic commodity instead of a cultural commodity. The Indonesian government has the same idea with the third element of craft by Greenhalgh (1997), craft as the politic of works.

Recently, as part of fourteen sectors in the creative economy programme, the craft has emerged into a craft design. The creative economy programmes facilitate a collaboration between a group of experts and craft makers to create a new design that more fitted to contemporary market (IKKON, 2019). The group consists of designers (i.e. interior designer and architect, visual designer, product designer, fashion designer, textile designer), anthropologist, ethnomusicologist, choreographer, photographer, videographer, and business developer (IKKON, 2019). Established in 2016, this programme had rejuvenated twenty frontier, outermost and least developed regions, often referred to as 3T (*terdepan, terluar, tertinggal*) regions (IKKON, 2019). This programme usually challenges the craft makers to advance their skills and to explore new techniques; this collaboration can be applied for *kerajinan* and *kriya*. The Indonesian government also support lots of annual international craft trade fairs that are usually held in Jakarta. The craft trade fairs have been a prestigious place for craft makers to meet national and international buyers. Some of the established events are the Jakarta International Handicraft Trade Fair (INACRAFT) that provides all type of crafts and Wastraprema that only accommodates traditional cloths.

The top-down and bottom-up initiatives have given a great impact on Indonesian traditional craft practices. Most of the initiatives have focused on developing the design related to the product and opening a new market to the newly developed product. The development is considered as a positive impact on the economy, resulting in an increase in GDP. Although the social impact has not been examined carefully. Questions arise on how the shifted situation with a more extensive manufacturing process has impacted into the craft practice, in terms of the craft makers' life and also the production process. This study is observing the answer through the Indonesian stitch-resist dyeing practice and the rationale for selecting this technique has been explained in section 1.2.1. Many craft practices have shown the ability and flexibility to continuously evolve and transform to modern society by adopting

an industrial production and modern technologies that go beyond the conventional modes of production (Tung, 2012; Chutia and Sarma, 2016). However, the imprudent adaptation of new technology can raise the risk of losing of the culturally significant aspects from the traditional craft practice in the long term.

1.2.3 Related studies of revitalisation craft practices

This study focuses on the culturally significant products or practices, which are associated to particular communities or localities because of their social, historical, and aesthetic values (Holroyd, 2018). These values are frequently associated with traditional artefact and craft processes (Holroyd, 2018). A craft process can be referred as a nonindustrial production-to-consumption system that includes products (crafted objects), skills (craftsmanship), producers (craftsperson), and trades or occupations (craft) (Reubens, 2016). There are three essential points associated to a traditional craft (Triharini, 2014). The first essential point is the purpose of traditional craft which is reproducing the traditional knowledge of the cultural origin. By recreating the traditional knowledge, the traditional craft will preserve the second essential point which is the values of craft, i.e. consistency, endurance, patience, accuracy, and the work ethic (Triharini, 2014). The third essential point is the craft skill that shows the ability to create the artefact and also to utilise a certain tool with a particular technique (Triharini, 2014). These characteristics of traditional crafts are essential to be promoted and considered when developing new designs or practices.

Since the early twenty first century, many studies had been conducted regarding commercialisation issues on culturally significant products or practices. Various studies were conducted under different focuses, some selected research are described as design for revitalisation (Evans et al., 2018), sustainable design (Walker, 2006; Reubens, 2016; Chudasri, 2018), transforming tradition (Nugraha, 2012), design anthropology (Triharini, 2014), design education (Askerud and Adler, 2015), social innovation (Manzini and Coad, 2015), and community development (Sugathan, 2015). These researches had helped to guide designers or researchers in conducting any culturally significant products or practices related activities.

Three studies that are considered to have the closest resemblance with this research aims are selected and discussed in this section; to explain the

aspiration frameworks for this study. These three selected frameworks had conducted research in relation to cultural significant designs, products and processes; they are the Design Routes approach (Evans et al., 2018), the ATUMICS model (Nugraha, 2012), and the Holistic Sustainability system (Reubens, 2016). These three approaches are derived from design perspectives with an aspiration to observe issues with more integrated and wider aspects. Each framework has its own method, and the comparison between them is outlined in Table 1.1. The comparison of these frameworks aims to present the different elements on each framework; in order to select the most relevant approach for this study.

Table 1.1 Comparison of three frameworks relating to culturally significant designs, products and processes.

Unit	The Design Routes (Evans et al., 2018)	ATUMICS model (Nugraha, 2012)	Holistic sustainability (Reubens, 2016)
Concept	Culturally significant processes, products and people	Transforming tradition based on artefact	Holistic sustainability in the craft production-to-consumption system
Method	Start with study the creative ecology of the case, and then choose the appropriate strategy. The strategy can be applied individually, but a novelty and innovation can result from combinations of multiple strategies.	Start with identifying the certain traditional feature elements on the artefact, and then combine with new elements modernity that has the potential to be fit in the contemporary lifestyle.	The study provides some checklists that can be applied to reach a holistic sustainability system. The frameworks are (i) Rhizome framework for marketing and design, and (ii) holistic sustainability checklist for design.
Elements / strategies related to design	Primary strategies: 1. Sustained through design, 2. Transpose tradition, 3. Value of place, 4. Skills,	Micro level elements: A = artefact, T = technique, U = utility, M = material, I = icon,	Elements on production-to-consumption system: 1. Production, 2. Design, 3. Marketing.

Unit	The Design Routes (Evans et al., 2018)	ATUMICS model (Nugraha, 2012)	Holistic sustainability (Reubens, 2016)
	5. Production processes	C = concept, S = shape,	
Additional elements / strategies related to design	Secondary strategies: 1. Promotion, 2. Enterprise, 3. Research and education.	Macro level elements: 1. Economically, 2. Socially, 3. Culturally, 4. Ecologically.	Design elements are focused on: 1. Economy aspect, 2. Social aspect, 3. Cultural aspect, 4. Ecological aspect.

Despite their different approaches, all the studies mentioned above (Table 1.1) believe in the same idea to some degree, which is to sustain or transform the existence of traditional craft products and practices without losing their cultural significance (Nugraha, 2012; Reubens, 2016; Evans et al., 2018). Every study produces a model or taxonomy, although each model has different focuses. The Design Routes focuses on craft as a whole, containing processes, products and people (Evans et al., 2018). Reuben's study focuses on craft as a holistic system, a nonindustrial production to consumption system (Reubens, 2016) while the ATUMICS model is focused on the artefacts or craft products by looking at the different elements on them (Nugraha, 2012).

Some studies also conduct similar research area, developing the traditional textile craft productions that are facing a similar impact of globalisation. Two case studies are discussed in this section; which are a study about the *Chok* weaving technique in Northern Thailand (Chudasri, 2018), and a research about recycle hand spun knitting yarn productions in rural India (Sugathan, 2015). Each study provided a different strategy. For the weavers in Thailand, Chudasri (2018) suggested that the designer can contribute in the development of product design and production scheme, the digital marketing and sales system, and the transfer knowledge in digital and non-digital. For the yarn production in India, the study suggested a solution by focusing on the community development and women empowerment with a sustainable cooperative model which included the production strategy and marketing system (Sugathan, 2015). These two studies display a variety of approaches based on the comprehensive research about the craft makers' community plus the socio-cultural and political situations in each country.

The selection of an appropriate framework depends on the research context, research question and also the researcher capability. It is crucial to select the most suitable framework to ensure maximum benefit for the community, in this case, the Indonesian stitch-resist dyeing crafts makers. The Design Routes taxonomy is considered to relate more with this study, providing several categories of revitalisation strategies that can be implemented for the stitch-resist dyeing practice. In this study, revitalisation is defined as an attempt to sustain or transform the existence of stitch-resist dyeing design, products and practices that are culturally significant with Indonesian tradition (Cassidy, 2018). This approach suggests a preliminary study of creative ecology where the craft makers operate. The successful application of a revitalisation strategy relies on an in-depth understanding of the context and culture of the creative ecology where the culturally significant design, products and processes exist (Jung and Walker, 2018). The definition of creative ecology is described as follows:

> *"A creative ecology consists of an interrelated set of situated factors that enable culturally significant creative practices to flourish. Intrinsic factors, comprising priorities, perceptions, motivations, values, responsibilities, and outlooks of those involved are supported by extrinsic factors involving connections to, and interactions among, associated organisations, resources, and activities." (Evans et al., 2018, p.357)*

The creative ecology is also defined as "the interrelationships between people, enterprise, practices, environment and so on that, together, serve to facilitate and support individual creative practitioners in their activities" (Jung and Walker, 2018, p.16). The creative ecology approach has a similar notion with design anthropology approach suggested by Triharini (2014). The design anthropology suggests a designer to apply a design thinking process with a deeper understanding of the local culture that surrounds traditional craft activity as a whole (Triharini, 2014).

Similarly, the creative ecology is referred as a reciprocal transaction of cultural information between people, individually or collectively, and every aspect of their environment (i.e. physical, social, psychological, economic, religious) that happens for both the situation and those engaged in the situation (Dillon and Kokko, 2017). The transaction of cultural information can become cultural patterns in given period of time, which later form cultural traditions and if they are endured, they become a cultural heritage (Dillon and Kokko, 2017). It means, the culturally significant product, designs, and practices, as part of cultural heritage, can be studied by

accessing the cultural information contained in transactions in the cultural ecology.

Taking all togethers, this study defines cultural ecology as the interrelated relationships between intrinsic factors (i.e. priorities, perceptions, motivations, values, responsibilities) and extrinsic factors (i.e. associated organisations, resources, and communities) as a cultural heritage that support the Indonesian stitch-resist dyeing practices. Thus, this study examines both intrinsic and extrinsic factors to construct the suggested revitalisation strategies.

1.2.4 The necessity and possibility of applying appropriate technology (AT) and organisation for textile craft practice

The fifth strategy of the Design Routes taxonomy, the production process shows similarities with the appropriate technology movement. In craft practice, technology plays an ambiguous role in which the mass-produced technology driven products threaten local crafts but at the same time technology offers the possibility of experimentation from within (Niedderer, 2009 in Dillon and Kokko, 2017). The appropriate technology initiates an idea to make the technology more productive than the indigenous technology but low in price compared to the sophisticated technology used in modern industry (Schumacher, 1993).

Appropriate technology is considered as pertinent for low-income countries where the technology is labour-intensive, simple to maintain and involves manufacturing products on a small scale with a minimally-harmful impact on the environment (Kaplinsky, 2011). The technology was expected to be affordable so it can be suitable for developing countries. However, these ideas have been developed into a broad definition of appropriateness which involves more aspects, such as social and cultural dimensions (Pellegrini, 1979; Hollick, 1982; Sianipar et al., 2013a; Sianipar et al., 2014). It was argued that the development of new technology in the craft practice can be more sustainable and feasible in the long term if it considers not only the economic aspect but also the other six important aspects: technical, environmental, social, cultural, judicial, and political aspects (Sianipar et al., 2013a). The appropriate technology is also believed to be an approach that is suitable for the culture, in particular, the community, by optimising existing skills and resources to raise the productive capacity and that can be

described as simple, cost-effective, and socially appropriate (Sugathan, 2015).

The challenge for appropriate technology studies is to understand the mechanisms underlying technology adoption; considering which technology is to be used, where and by whom (Schumacher, 1993). In other words, the improvement of existing technology should be based on the user's culture; which also related to the concept of creative ecology from the Design Routes (Jung and Walker, 2018). Additionally, the appropriate technology should be well-related to the cultures to meet the local needs and avoid any resistance by the user (Hazeltine et al., 1998). Thus, it should improve people's living conditions without significant changes and cultural damage. In this context, culture can be defined as customs, and standards of taste as an essential mediator and adversary to the non-cultural, which are the mechanical and the artificial realm of technology (Hazeltine et al., 1998).

The application of appropriate technology needs to be built upon a deep understanding of human needs – both individual and social on wide cultural variations (Hollick, 1982). There were many cases where the commercialisation and global expansion of certain craft industries without prioritising the user can lead to severe localised effects (Scrase, 2003). One of the examples was the case of Indonesian textiles, where the development of this industry into an extensive and commercialised manufacturing process which created 80,000 jobs led to the subsequent demise of an estimated 410,000 traditional artisan jobs in weaving and associated crafts like dyeing (Buchanan, 1985 in Scrase, 2013). Those deprivation of craft practices showed a lack of appreciation for cultural value in the artisan work, and the economic aspect would have been the main drive in decision making. An application of more appropriate technology can sustain the economy and also a cultural aspect in a longer-term.

This study learnt that the natural shift phenomena in the *batik* process (Gillow, 1995) as one of the successful examples of applying appropriate technology into a traditional textile technique. The introduction of a new tool, copper block-printing, was a clever transformation from the traditional movement in an adaptation of social force, without losing the value of the *batik* process. The *batik* was being forced to fulfil a high demand from the new market created by the Dutch colonials at that time. That situation was a challenge for the *batik* tradition, either to develop and survive or go extinct. In result, the authentic *batik* pattern has been preserved, and it has also

been modernised with a new invention of pattern design. This phenomenon is also a good example of transforming tradition by changing the element technology, as one way of preserving traditions (Nugraha, 2012). It is expected that a similar concept could be applied to the stitch-resist dyeing technique, considering their close related method in textile making.

In order to find the appropriate way to revitalise the craftsmanship, some frameworks have been analysed. Brunn (1996) developed an analytical framework for selecting and introducing appropriate production technology in developing countries. Several points taken from the study are the acknowledgement of soft technology (knowledge, organisation and product) which also as important as the hardware technology itself. It implies that understanding the products, processes and people are very important before going to the three frameworks: conceptualisation, implementation and operation, which also includes maintenance and improvement. The study also introduced the incremental stage in applying the appropriate technology. In correlation with Brunn (1996), Wicklein (1998) created some criteria to examine the appropriateness of technology in developing countries by identifying and analysing the social contexts of a given culture along with its current level of technological development. Further details about the appropriate technology and organisation frameworks are discussed in chapter 6.

The appropriate design technology could be adopted to develop the techniques to be socially relevant, culturally meaningful, and economically fair (Janzer and Weinstein, 2014; Holroyd et al., 2015; Sugathan, 2015; Cassidy, 2018). This study argues that the critical aspect to face the current challenges in stitch-resist dyeing technique is by selecting an appropriate method to develop the stitch-resist dyeing technique without losing the cultural aspects. By optimising the technique and supported by the appropriated organisation, the community can get more advantage in an economic aspect which means sustaining the tradition of the stitch-resist dyeing process on the community.

1.3 Research aims and objectives

After deliberately studying the Indonesian culture and the issues with the commercialisation of craft products and practices, this research has two

aims; first, is analysing the Indonesian stitch-resist dyeing technique and practices after the commercialisation. A comprehensive study is developed to gain a depth of understanding about stitch-resist dyeing technique among Indonesian craft-makers in three locations and the culture behind this. This study also produces updated documentation about the technique to preserve the tradition. Second, is suggesting revitalisation strategies focusing on the appropriate technology and organisation to optimise the quality of the technique that enhance with the Indonesian government policies in cultural heritage preservation. In short, this study aims to analyse the commercialisation phenomenon of the Indonesian stitch-resist dyeing traditional practice in order to formulate appropriate revitalisation strategies with a perspective on the cultural aspects.

Research Objectives

The following objectives have been set to achieve the research aims:

1. To analyse the cultural value, the technique sequence and the organisational structure of Indonesian stitch-resist dyeing technique after commercialisation in three locations in Indonesia as case studies.
2. To examine the correlation between prominent factors of the Indonesian stitch-resist dyeing technique with the resultant patterns.
3. To identify and construct appropriate revitalisation strategies to accommodate the challenges and sustain the current Indonesian stitch-resist dyeing practices based on primary and secondary data.

Research Questions

To address the research aim and objectives, the study answers the following research questions:

1. How has the transformation of the traditional stitch-resist dyeing cloth’s function impacted the production process and social structure of the craft maker community?
2. What are the prominent factors of Indonesian stitch-resist dyeing technique? How do the prominent factors affect the resultant patterns?

3. What are the emerging issues that occur from the transformation in three locations of stitch-resist dyeing practices in Indonesia?
4. How to construct a new framework to accommodate the challenges of current Indonesian stitch-resist dyeing practices without losing the cultural aspects? How will the new framework affect to the current Indonesian stitch-resist dyeing practices?

1.4 Thesis outline

This research consists of seven chapters that are outlined as follow:

Chapter 1 introduces the background of this research, the problem contexts, the research aims, the research objectives, and the research questions.

Chapter 2 critically reviews related literatures which describes, compares and discusses the stitch-resist dyeing technique and supplementary related methods.

Chapter 3 discusses the research methodology of this study which contains the research purposes, the research type, the research framework, and the research methods and tools.

Chapter 4 centres on a study of the Indonesian stitch-resist dyeing practice, based on a survey in three locations: Palembang, Banjarmasin and Yogyakarta. The areas were selected to represent the problem of this research which is the non-industrial textile craft practice that employs the stitch-resist dyeing technique. The cultural, social, economic, and technical issues are the main aspects of the survey.

Chapter 5 examines the correlation between key factors of the stitch-resist dyeing process and their resultant patterns. The key factors are defined based on the findings from the survey in chapter 4.

Chapter 6 discusses the appropriate revitalisation strategies for the Indonesian stitch-resist dyeing based on findings and issues that compile from the previous chapters.

Finally, **chapter 7** presents conclusions and discussions towards pertinent findings and issues covered in the previous chapters. Several recommendations for further work are given at the end of this chapter.

Chapter 2
Literature review of stitch-resist dyeing technique

This chapter aims to provide a description of the stitch-resist dyeing technique as the main focus of this study. The origin of this technique is explained in section 2.1, followed by the definition in section 2.2. The sequence of stitch-resist dyeing process is described in section 2.3 – 2.7. The discussion ends with some examples of advance approaches that produce the similar effects of stitch-resist dyeing technique (section 2.8). A summary of this chapter is provided in section 2.9.

2.1 The origin and locations of stitch-resist dyeing technique

The various procedures of resist dyeing have a close affinity among different type of resist dyeing technique (Buhler, 1954, p.3748), therefore the discussion of stitch-resist dyeing technique's origin and locations in this section is interrelated with the resist-dyeing technique. Stitch-resist dyeing or *tritik* is also frequently recorded as a combination of tie-dyeing technique (or *plangi* process*)* according to the literature (Buhler, 1954; Robinson, 1969). The origin of the resist dyeing technique (i.e. including all types of resist dyeing) remains unclear partly because limited very ancient samples remain as fabrics disintegrate in time and subject to weathering (Meilach, 1973). Furthermore, it is very difficult to trace the origin of the resist dyeing technique since the acculturation process occurred over centuries which caused a cross-fertilisation of techniques and ideas (Hann, 2013). Therefore, it is inadvisable to examine the historical connection of this technique based on the resemblance or the identity of the cloths' decorative patterns (Buhler, 1954: 3752). Nevertheless, it is important to review similar techniques in other locations to associate the Indonesian stitch-resist dyeing designs and practices that presumably had been influenced by other cultures outside Indonesia.

The resist dyeing technique as a method in creating textile designs has long been used by textile makers from simple patterns and has developed into more complex ones. The resist dyeing method is acknowledged as a very

old form of pattern-making using simple equipment which allows it to be engaged in any conditions (Robinson, 1969). With an established history throughout the world, the resist dyeing method has been applied and modified by different countries, which creating distinctive and culturally significant patterns (Robinson, 1969).

The resist dyeing technique has been practised in all parts of the world, apart from Australia and Oceania (Buhler, 1954). The resist dyeing technique in Japan is called *Shibori* (tied or knotted) or *Yuhata* (tie-dyeing fabric together) as an earlier term (Wada et al., 2011). In Africa, especially in Senegal and Nigeria, the technique is called *Adire* and uses stitching in its various forms, such as over-stitching, gathering, pleating and machine stitching to create different effects before indigo dyeing (Boscene, 1985; Hann, 2005). A similar technique was also found in several countries in South East Asia such as Thailand, Cambodia, and Indonesia, where Palembang, Java and Bali are considered the main centres for the technique (Robinson, 1969).

The long history of textiles in Indonesia had been influenced and acculturated by different cultures over centuries. Most Indonesian textiles, in technological and design aspects, can be linked to the Asian mainland (Hitchcock, 1991). There are two distinct theories related to the origins of the resist dyeing technique in Indonesia. One theory supports idea that the resist technique originated from mainland Asia and then spread to the Malaysian area (close to Indonesia); another theory claims that the *batik* method was indigenous to the Indian archipelago (Indonesia area) and then spread to the Western world (Meilach, 1973). The cultural diffusion of Indonesian textiles mainly came from trade activities with India and China, and also from Hinduism and Buddhism religions since Indonesia lies at the crossroads of ancient migration paths and, later, trade routes through Asia and the Pacific (Forman, 1988; Hitchcock, 1991). *Batik* was mentioned for the first time in a historical record on a palm scroll dating from AD 1520 and another record was mentioned of a shipment of *kembangan* fabrics that was shipped from Java in AD 1850 (Buhler, 1954, p. 3751).

Continual contact with foreign invaders, colonisers, missionaries, merchants and traders is known to have brought a marked effect on the development of Indonesian textiles (Gillow, 1995). The cultural diffusion was stronger in the heartland of the Indonesian people, such as the coast of Sumatra, throughout Java, Bali, and on the Kalimantan and Sulawesi coastal areas

(Gillow, 1995). The emergence of Hindu-Buddhism in the fifth century, the rise of Islam in the fourteenth and fifteenth centuries, and the Dutch colonial rule for three hundred years that began in the seventeenth century shaped every island differently (Hout, 2010). The emergence of Hindu-Buddhism in Indonesia was steadily absorbed with the contact of India and China (Maxwell, 2003). The earliest Indian contacts with Sumatra are thought to have taken place in the first and second centuries and developed the kingdoms in Central Java and Southern Sumatra (Hout, 2010). As a result of this acculturation, Indonesian textiles adapted the ancient indigenous ideas of Indian style and design that have created difficulties in distinguishing between the two textiles; this is most obviously shown in traditional textiles from Palembang, south east Sumatra (Gillow, 1995, p.88). It can be concluded that the Indonesian stitch-resist dyed cloths receive influences from other cultures which has appeared on the design, technique and material. Most of Indonesian artisans absorbed and reinterpreted the imported techniques, then developed the imported technical processes to a level which rose far above the original (Forman, 1988), and at the end, represented the Indonesia culture.

2.2 Stitch-resist dyeing technique

This section aims to provide a comprehensive explanation of the main subject in this research, stitch-resist dyeing technique. The technique is part of resist dyeing technique group; thus, the discussion begins with an explanation of resist dyeing technique generally, continues with a description of stitch-resist dyeing technique specifically.

Design creation on textiles can be classified by two types of colouration: first, by applying the colourants directly to the textile surface; second, by applying a resist substance on the textile followed by the colourants (Wells, 2000). The second type is commonly known as the resist dyeing methods. The resist dyeing is considered as a term used to encompass a broad spectrum of techniques by which yarn or fabric may be decorated through allowing dyestuff to come into contact with selected areas on the yarn or fabric's surface (Larsen et al., 1976, p.12). It implies that two media can be applied to the resist dyeing method: fabrics or yarn. Covering some parts of fabrics, mostly woven cloths, is categorised as surface design; whilst covering some areas on the yarn before it is woven is known as a structural design method.

The latter method is also known as *ikat* in Indonesia, which is used widely in certain areas in Indonesia (Robinson, 1969).

Seiler-Baldinger (1994) considered the resist dyeing technique as an indirect ornamentation method because the process of designing is not directly applied onto the fabric, but by covering specific areas of fabric with a resist substance before the colour application process. The process of indirect ornamentation is considered highly complex compared to direct ornamentation (Seiler-Baldinger, 1994). Multi-coloured patterns using an indirect ornamentation method can be achieved by (i) repeated application of dyestuff or by (ii) removal of resist substances in a series of stages linked with the various processes of dyeing (Seiler-Baldinger, 1994). The colouring methods for stitch-resist dyeing are discussed in section 2.6.

Methods for applying resist substances can be classified as a mechanical, physical, and chemical, which the traditional methods are mostly applied with mechanical and physical methods (Wells, 2000, p.126). The mechanical method refers to an application of wax, fats or starch with specific tool on the fabric surface, e.g. *batik* process. The physical methods relates to any physical resistance applied directly with threads or ropes, it can be tied, stitched or clamped. The latter method is well-known as a tie-dye technique, which creates an authentic character of soft blurred pattern around the resist area (Wells, 2000, p.126). Other classification of the resist dyeing technique was based on the individual application method, which are: binding, knotting, plaiting, folding, stitching, tie-dyeing, clamping, stencil resist dyeing, *batik* (application of paste or liquids), and negative resist methods (Singer and Spyrou, 1989; Seiler-Baldinger, 1994). Each method can be applied separately or in combination and the results can be very complex and intricate, as no two designs can have the same result (Singer and Spyrou, 1989). This study focuses on the stitching method as resistance.

The definition of stitch-resist dyeing technique is a textile method requiring the application of running stitches or whipping stitches (overstitch) on the woven cloth, and then the sewing thread is gathered and knotted at the end to protect the area from dye penetration (Belfer, 1972; Larsen et al., 1976). In result, the act of pulling and fastening the sewn thread produces some pleats which prevent the colour from penetrating the cloth underneath. Singer and Spyrou (1989) explained that the basic sequence of producing a pattern on the fabric using stitch-resist dyeing could be divided into five steps. First, transfer the design on the fabric surface. Second, sew a running

stitch on the drawn fabric using strong thread, most people use hand-stitching, but machine stitching also can be used for different effects. Third, gather the fabric together by pulling the threads and fasten tightly at the ends of the threads to hold the pleats securely. Fourth, apply colour on the cloth to create a contrast between the new colour and the existed colour. The colouring process can be done in various ways and either only one time or several times. The fifth and final step, untie or release the knot to reveal the pattern (Figure 2.1). The success of this method is entirely dependent on the ability to gather and fasten the thread very tightly at the end, so the knotted thread is strong enough to hold the pleats tight during the dyeing process (Maile, 1969, p.74). Each step of the stitch-resist dyeing method is described extensively in the following sections 2.3 – 2.7. The explanation covers the basic principle and some relevant variations on each step.

(i) (ii) (iii) (iv) (v)

Figure 2.1 Photographic images of the stitch-resist dyeing process illustrating its sequence.

The sequence details are: (i) drawing the design; (ii) applying running stitches; (iii) pulling and fastening the thread; (iv) colouring the cloth; (v) resultant pattern.

In order to obtain the intended patterns, the selection of materials is essential. In general, a variety of woven fabrics can be used for this technique. Although, a medium to finely woven fabric was recommended to create a clear pattern (Maile, 1969). The recommended fabric refers to a

high density fabric with high yarn number. Fabric density indicates the number of warp yarns and weft yarns in a one-inch square. Higher fabric density indicates a denser fabric, where the higher yarn number indicates the finest yarn. A thicker fabric with low density is more difficult to keep the pleats gathered tightly.

The technique requires a sturdy thread that glides smoothly through the cloth when it is gathered. It is essential to have a strong thread that remains taut while supporting the weight of the tightly gathered cloth during the coloration process (Maile, 1969). A robust unbreakable pineapple leaf thread was used in Indonesia (Gillow, 1995). Using a fine strand of raffia as the sewing thread was widely practised in West Africa (Maile, 1969). In the early-twenty-first century, three-ply cotton sewing thread, nylon upholstery thread or nylon fishing lines are more commonly used (Meilach, 1973; Brito, 2002). The selection of thread affects the option of needle size. A long and thin needle helps to ease the sewing process since it picks many stitches before the thread needs to be pulled through. Although, a small needle size has a little eye which makes it more difficult to insert the sewing thread (Brito, 2002) (Brito, 2002). Crewel needles that are common for embroidery and tapestry can be used as another option. These can accommodate a thick thread without unnecessary bulk which can cause permanent holes in the fabric (Maile, 1969; Singer and Spyrou, 1989).

2.3 Designing and transferring stitch-resist dyeing patterns

Designing a stitch-resist dyeing pattern is based on how the thread is sewn on a fabric surface. The sewing needs to follow a drawing or sketch that has been applied beforehand on the fabric. The resultant pattern generally resembles a line consisting of a tiny slightly diffused circle with a small pin hole in the centre (Forman, 1988; Ellis, 2005). The dots are created from the sewn thread passed through the fabric and the little circles where surrounded the dots visually appear from pleats being compressed. Gathering the sewing threads forms the pleats on fabric. These features are the authentic marks resulting from this method, tell-tale signs of the technique (Majlis, 2007).

The stitch-resist dyeing patterns are strongly associated with linear design (Hann and Thomson, 1993; Gillow, 1995). In this particular context, linear

design can be defined as a composition predominantly formed using lines or outlines (Oxford, 2019). The line is formed by connecting one point to another, and it can be straight line, curve, spiral, diamond, square or combination in between points (Meilach, 1973). The two connecting points represent two knots that hold the pleated fabrics after the sewing thread is being pulled and knotted (Maile, 1969, pp. 84-90). Some illustrations explaining different lines combination in designing the stitch-resist dyeing pattern are presented in Figure 2.2.

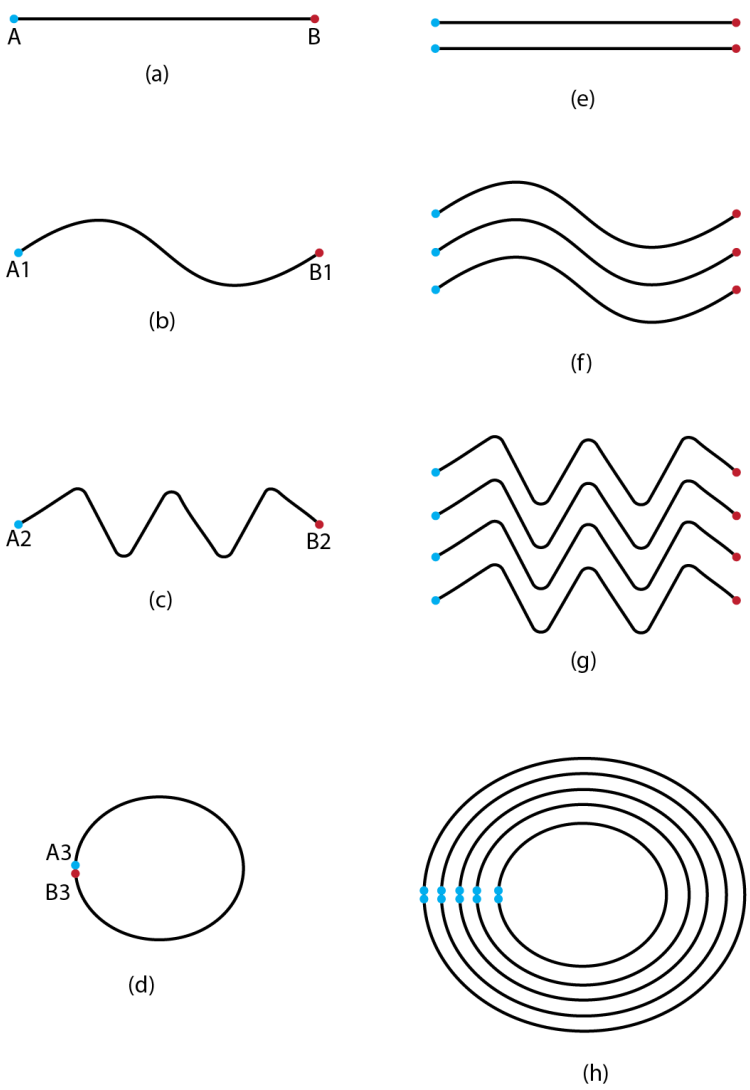


Figure 2.2 Illustrations of different types of line(s) for the stitch-resist dyeing design.

Description:
(a) single straight line;
(b) single wavy line;
(c) single zigzag line;
(d) single loop line;
(e) double straight lines;
(f) triple wavy lines;
(g) quadruple zigzag lines;
(h) quintuple loop lines.

Point A can be considered a starting point of the sewing technique and point B is the finishing point. Sewing from point A to point B can create a straight line (Figure 2.2a), a curved line (Figure 2.2b), a zig-zag line (Figure 2.2c) and a loop line (Figure 2.2d). The number of lines can be single, double (Figure 2.22e), triple (Figure 2.2) or more (Figure 2.2g - Figure 2.2h). Then, those lines can be placed parallel (Figure 2.2a - Figure 2.2g) or diagonal (Figure 2.3a). Involving more than 2 lines creates an outline of complex figures, such as a flower, a butterfly (Figure 2.3b), a dragon and many more. Explanation on the following sections refers to Figure 2.3a and Figure 2.3b as an example of different pattern requirement.

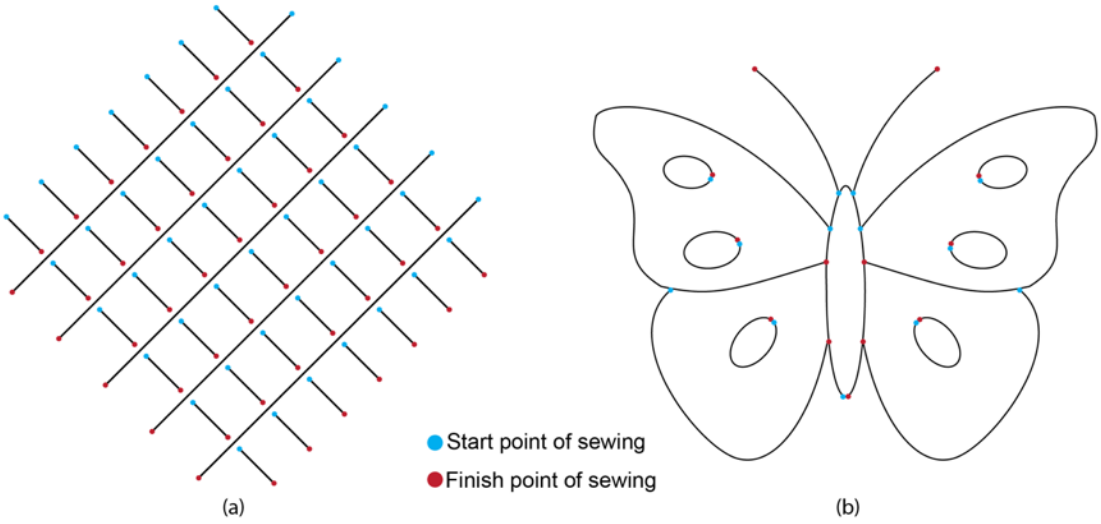


Figure 2.3 Illustrations of different composition of lines for the stitch-resist dyeing design.

Description: (a) an example of diagonal repetitive lines;
(b) an example of complex figure lines.

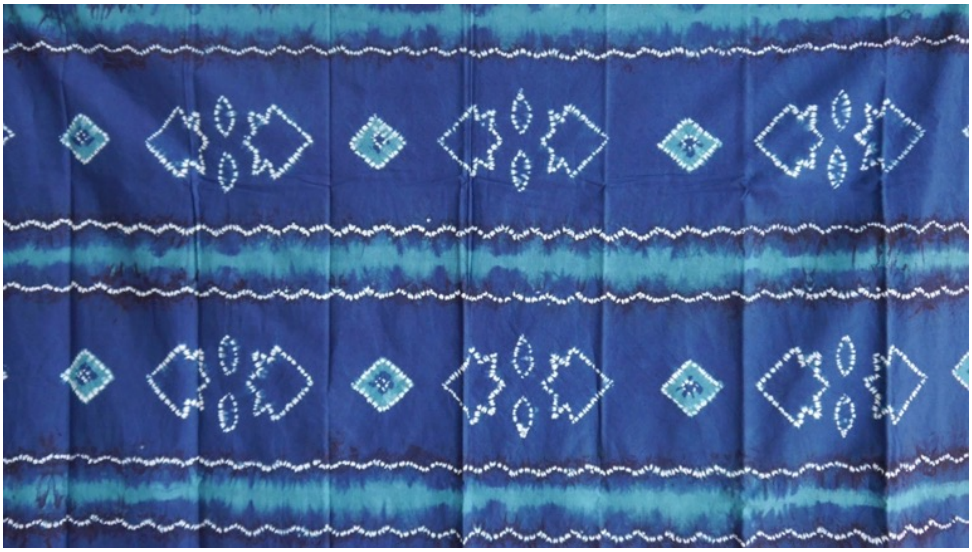


Figure 2.4 Traditional *Sasirangan* cloth composition from Banjarmasin, South Kalimantan, Indonesia (photo was taken during the survey 2017).

It is essential to understand the basic idea of creating a line because it can help to determine the order in applying the stitches when the design becomes more complicated. In other words, creating a design for the stitch-resist dyeing technique is mainly a process of arranging lines with good composition, then adding the colour combinations for the realisation. The composition consists of multiple lines in a horizontal orientation, with a combination of symbolic figures in between is seen in the traditional *Sasirangan* cloth composition from Banjarmasin (Figure 2.4).

For the stitch-resist dyeing technique, the majority of designs can be categorised into two groups: single patterns and repetitive patterns. A single pattern is usually an intricate figurative pattern that functions as the main motif of the fabric. The most used figures are flowers, animals (butterfly, dragon, birds) and scenery. A repetitive pattern is created by replicating a modular motif. Repeating motifs can be arranged in a simple manner or a complicated one, which can be difficult to see the repetition arrangement. There are three categories of repetition forms: spot repeats, border-frieze repeats and all-over repeats (Wells, 2000, pp. 66-68). The all-over repeats category is more commonly apply in a printed design than in a stitched-resisted design.

Figure 2.5 Eight types of networks in modular repetition.

Description: (a) square or full-drop network; (b) brick network; (c) half-drop network; (d) diamond network; (e) triangle network; (f) ogee network; (g) hexagon network; (h) scale network (adapted from Wells, 2000, p. 67)

The first category, spot repeat, is an arrangement of a single module randomly or with order. Any isolated image can be used as a single module, for example: geometric shapes (circle, diamond, square and polygon) or simple figurative motifs (leaf, flower, bird). Wells (2000) described eight networks as a popular order for designing modular repetition patterns (Figure 2.5). The square and half-drop networks are the most popular networks in textile design (Wells, 2000). Each network can be modified by changing the distance between lines or the size of a network. It determines the distribution of each module; the closer grid lines creates compact repetitions while the further apart grid lines creates more spot effects (Wells, 2000). The second category, border repeat, is constructed by repeating one or more design elements (e.g. lines, zigzag, spirals, circles, chevrons) in a line (Wells, 2000). The border can be a continuously linked pattern, or a combination of different elements separated by a gap (Wells, 2000). As one the oldest method of decorations, border repeats can be found in many traditional Indonesian fabrics (Hitchcock, 1991).

The first step after designing a pattern for the stitch-resist dyeing technique is transferring the design on the cloth. The initial design generally is

sketched on paper first and then transferred to the fabric with a suitable method. Otherwise, the transfer method is by free drawing directly onto fabric. For the design with a single motif, it is suggested to use a single layer of fabric and draw the design using a soft pencil or fabric pen (Singer and Spyrou, 1989). The dressmaking pens and water-soluble crayons leaves marks that disappear when soaked in water or reacted with air, so it creates a neat clear line even on delicate or slippery fabrics (Brito, 2002). Although, the time consideration should be adjusted as some dressmaking pens fade out overnight, and even quicker in humid conditions.

For the design with symmetrical and repeatable patterns, the fabric can be folded once or several times depending on the required number of repetitions. The width of the folded fabric depends on the size of a single module. Applying the sewing thread on folded results a mirror effects in the pattern. The popular transferring method is achieved by putting a dressmaker's carbon paper between layer(s) of folded fabric and then drawing the pattern with a pencil or tracing wheel, as long as it gives pressure throughout the carbon paper(s) (Singer and Spyrou, 1989). Figure 2.6 shows an illustration of mirror effects on folded fabric by applying carbon papers in between layers. The other way to produce a precise result is by folding and ironing the fabric following the size of a single module, then stabilising the folded fabric with pins or using baste stitches to keep the fabric from moving (especially with a silky fabric). With either method, the drawing is only applied in a single module. This method also reduces the chance of making mistakes if the running stitches in the first layer do not meet the exact position on the second or third layer. For producing a repeat pattern, some template or stencil can be applied to help with speed and accuracy (Brito, 2002).

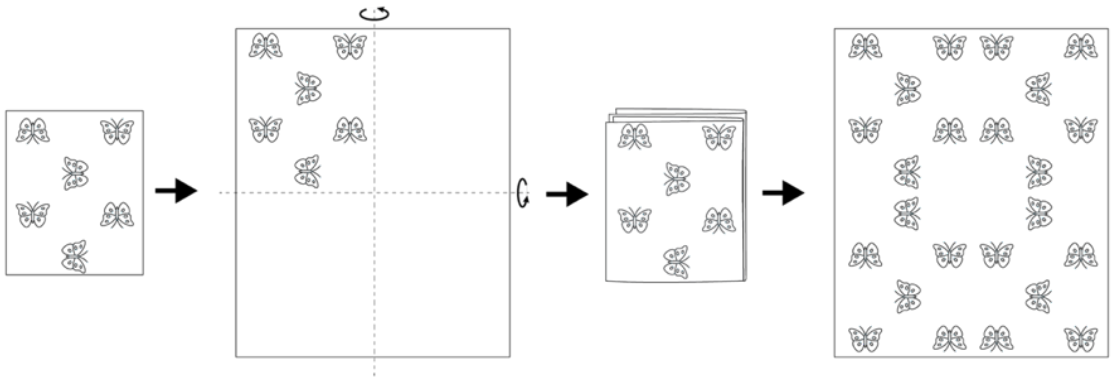


Figure 2.6 Illustration of a mirror effect as a result of folding the fabrics.

2.4 Sewing process in stitch-resist dyeing technique

Once the design has been transferred to the fabric, the next step on stitch-resist dyeing method is sewing the pattern. The purpose of sewing the fabric is to create regular pleats that prevent a selected area of fabric from being reached by the colouring substance. The following discussion focuses on the hand stitching process, although some of more modern practices are employing a sewing machine (Singer and Spyrou, 1989). The technique is mainly sewn by hand with two types of stitches: running (or tacking) stitches and whipping (or over-sewing) stitches (Maile, 1969; Meilach, 1973). The way of manually applying a running stitch on the fabric is simply achieved by placing the needle in and out on a flat fabric with a forward motion (Figure 2.7a). The whipping stitches are applied over a hem or a folded fabric, as shown in Figure 2.7b. The application of running stitches for the stitch-resist dyeing technique is more common than the whipping stitches. It is mostly because the running stitch has more flexibility in term of its position leading to increased potential to be creative in designing patterns.

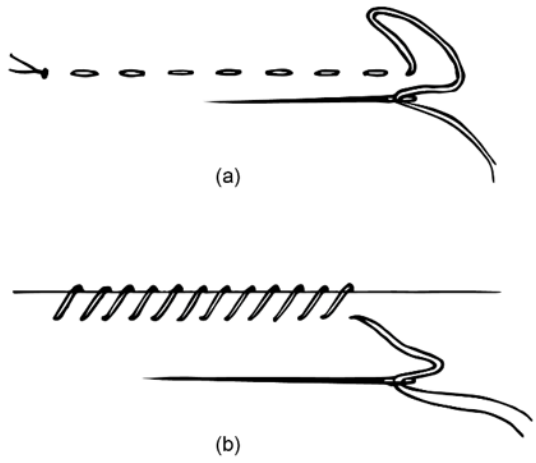


Figure 2.7 Illustration of (a) running stitches, and (b) whipping stitches.

The technique can use a single thread or double thread. The decision of using a single or double thread is depended on the type of pattern and also the thread number. The higher thread number means the finer thread, which in this technique it requires a double thread. A single thread is sufficient if employing a sturdy thread or for a small pattern. Double thread is essential if applying a more fragile thread or for a larger pattern; for example, if the

pattern extends across the cloth (Maile, 1969). Such decisions are made to avoid the thread snapping during the fastening stage and colouring stage, which lose or obliterate the pattern completely. However, the resultant pattern properties may be varied - visual or tactile- by using coarser or finer thread as well as small or large stitches (Maile, 1969). By small or large stitches, Maile (1969, p.82) referred to the length of each stitch (Figure 2.8a) and distance between stitches (Figure 2.8b). Both the stitch length and distance between stitches are more likely to be applied in a regular size (Figure 2.8c), but it is not ruled out to apply them irregularly (Figure 2.8d). Very few publications have defined either of them by a specific number, so the exact stitch length and distance between stitches have remained unclear. It has been reported, however, that individuals with more practice using stitch-resist dyeing technique provide a better understanding on which designs that require a small stitch, a long stitch or a combination of both.

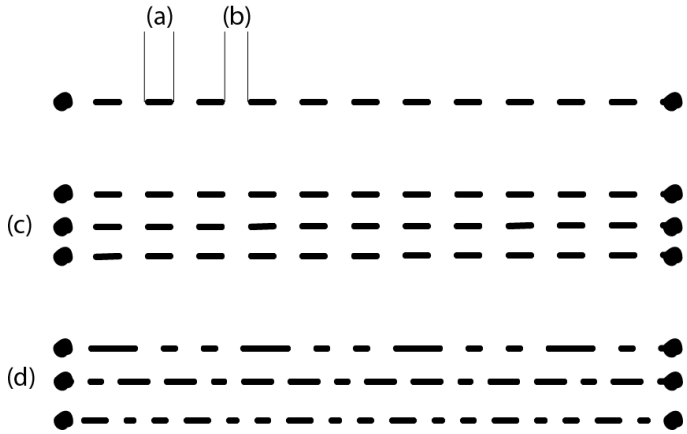


Figure 2.8 Illustration of the running stitches structures.

Description: (a) the stitch length; (b) the distance between stitches; (c) regular stitch length; (d) a combination of small and large stitches

The most important rule in conducting the sewing process is to always use a large knot at the end of the thread before beginning to sew. The bulky knot can be obtained by applying two or more knots above one another. As an additional precaution, another large knot can be made on the other end of the sewing thread, once it reaches the end of the pattern and after it is taken out of the needle (Maile, 1969; Singer and Spyrou, 1989). Double knots at each end of the thread prevent the stitches from loosening accidentally

during the gathering and fastening stage, especially if the entire pattern has more than one stitch line. It is strongly suggested to sew all the entire pattern before beginning to pull up the threads, because it is easier to sew the fabric on a flat surface than on a partially gathered piece of cloth (Maile, 1969). Some stitches can be picked partly in a larger pattern as long as there is a generous gap between the area that is being sewn and the area that has been bunched up, so the rest of the sewing process can be carried out comfortably and precisely (Maile, 1969).

2.5 Pulling and fastening process in stitch-resist dyeing technique

Once the sewing process has covered the whole area, the next step of the stitch-resist dyeing technique is gathering the fabric and fastening the pleated fabric. Both steps are considered as one set because pulling the fabric is aimless if it is not being fastened at the end. Coarser fabric can be difficult to gather because its stiffness, and in contrast, silky fabrics is easy to gather. However, the silky fabrics is more challenging to hold the bunched of pleated cloth because of they are slippery. The best way to pull the fabric is by gradually sliding the cloth along each sewing thread and at the same time making sure the pleats are on the right position until all pleats are tightly gathered at one end (Maile, 1969; Singer and Spyrou, 1989). The pulling process is a key part in arranging the pleated fabric to fold regularly and the sewing thread should not be visible. Any irregular pleat can cause an untighten area which affects the resultant pattern. The use of contrast colour between the sewing thread and the fabric is beneficial in this manner.

The act of pulling and fastening the sewing thread is a straightforward process in simple pattern. However, the intricate patterns require a well-plan order of pulling and fastening so the sewing thread is not tangle during the processes. For repetitive multiple lines patterns, pull the sewing thread consistently with linear order starting from one side to the other side (Figure 2.9a). For figurative patterns, gather the thread with radial order, from inside to outside (Figure 2.9b). For both types, it is recommended to start with a shorter line or a smaller pattern.

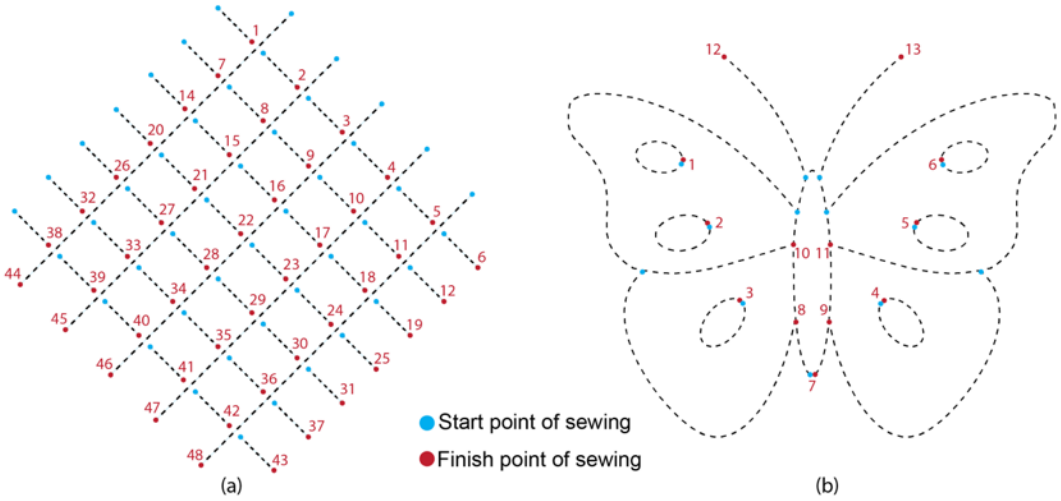


Figure 2.9 Illustration of pulling the sewing thread with (a) linear order and (b) radial order.

The number on each pattern shows the order for pulling the sewing threads.

After gathering the fabric tightly, the ultimate success of the pattern depends on a firm secure fastening (Maile, 1969). The only way of fastening that has been used so far by the makers is by creating a knot. The knot is the only object that withstands the pleated fabric, or we can refer the pleated fabric as the resist area. The knot should be bulky enough to keep the tightly packed folds of cloth from bursting away and should not slacken in the slightest while the sample is dyed (Maile, 1969). The discussion of the fastening method covers how to make an ideal knot in different circumstances when it comes to various patterns. The position of the end thread is different for each pattern. The discussion describes five most frequent circumstances which should cover any eventuality, as follows:

1) Basic knot for line(s)

Particular line(s) can be defined as any single line (e.g. Figure 2.2b and Figure 2.2c) or pattern (e.g. Figure 2.3a and parts of Figure 2.3b) where the starting point and the endpoint of the sewing are in a different position. The discussion of double or more lines is presented in the next section. There are many methods of applying a basic knot at the end of the thread, but this section presents the most common one. The illustration of each step is described in Figure 2.10.

a) Complete a row of sewing and then cut the thread three or four inches beyond the cloth. Gather the fabric until it is bunched into a compact mass at one end (Figure 2.10a).
b) Hold the pleated fabric with one thumb (usually the left thumb for a right-handed person) while the right-hand holds the end of the sewing thread (Figure 2.10b).
c) Create a loop with the sewing thread on the spot where the thread emerges from the last fold of fabric with your right hand and then hold the crossing of two strands with your left thumb (Figure 2.10c).
d) Establish the knot by passing the thread into the loop and pulling it tight while the left thumb still holding the crossing thread (Figure 2.10d).

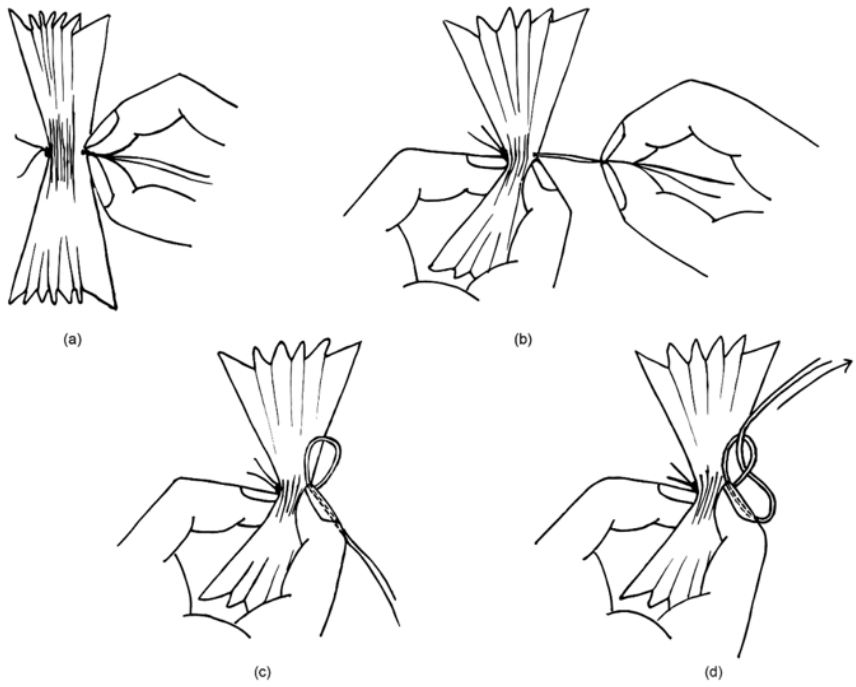


Figure 2.10 Four steps for making the basic knot on the stitch-resist dyeing technique.

It is crucial to make sure that the left thumb holds the crossing thread tightly so there is no gap between the knot and the last cloth. The gap means the tie is loose and affects the resultant pattern. It is suggested to create more than one knot by repeating the steps if a fine thread is used.

2) Separating a double thread

The first benefit of using a double thread is to prevent breakage during the fastening stage, and second, is to separate the two strands and tie them together into a big knot (Brito, 2002). Detailed steps for the method are described as follows (Maile, 1969) and are illustrated in Figure 2.11.

a) Complete a row of sewing and then cut the thread three or four inches beyond the cloth. Gather the fabric until it is bunched into a compact mass at one end.
b) Separate the two strands and then pull them in opposite directions.
c) Give a final tug to tighten the pleated fabric before tying them into a first single knot. It is advisable to repeat step c several times to build up a knot, big enough to keep the cloth from slipping off the thread.

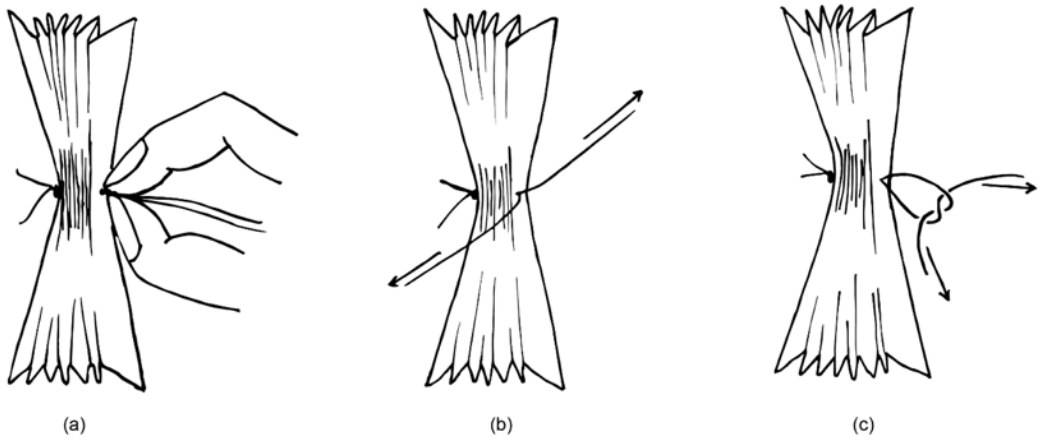


Figure 2.11 Separating a double thread method

3) Tying method for loop pattern

The loop pattern is defined as any curve line that bends around and crosses itself which means the starting point and the endpoint of the sewing thread are in the same position. It means there are two ends adjoining one another (Maile, 1969). Thus, the best way of fastening off after pulling up the threads is to tie the two ends together. The method is very similar with previous type, separating a double thread (Figure 2.11). The both ends are considered as a unit of thread, either it employs a single or double thread. It is advisable to tie them several times to build up a big knot.

4) Back-stitching

The back-stitch method can be used for fastening the cloth either using a single or double thread. The important thing to be considered for applying the back-stitching method is the pattern order since the sewing thread is pulled and fastened instantly after finishing each motif. The pattern needs to have enough space between the singular motifs so it leaves a sufficient space to carry on sewing the next motif. The other alternative to avoid pulling and fastening instantly is by using more than one needle. Each step of back-stitching method is described as follows (Maile, 1969; Singer and Spyrou, 1989):

a) Gather and tighten the fabric to its limit, right away after all the sewing has been completed.
b) Grip the bunched-up cloth, while at the same time the left thumb presses securely on the spot where the thread emerges from the last fold of cloth.
c) Sew the backstitches firmly a couple of times at the same spot to avoid the thread slackening and the fabric coming apart.

5) Making a false end for tying

This particular method can be useful if a single thread is being used, and the basic knot and back-stitching methods are impracticable (Figure 2.12a). It mostly happens on a small pattern where the thread is predicted to be too short for applying the other two methods even after gathering the fabric. The steps for making a false end for tying are explained as follows (Maile, 1969, pp.75-76):

a) Complete a row of sewing and make a substantial knot at the end to avoid slipping while creating the false end.
b) Prepare a new thread and make a substantial knot at one end.
c) Sew one or more stitches to the cloth adjacent to the existing one (Figure 2.12b).
d) Now, the short end can be tied up with the additional end by following the separating a double thread method (Figure 2.12c).

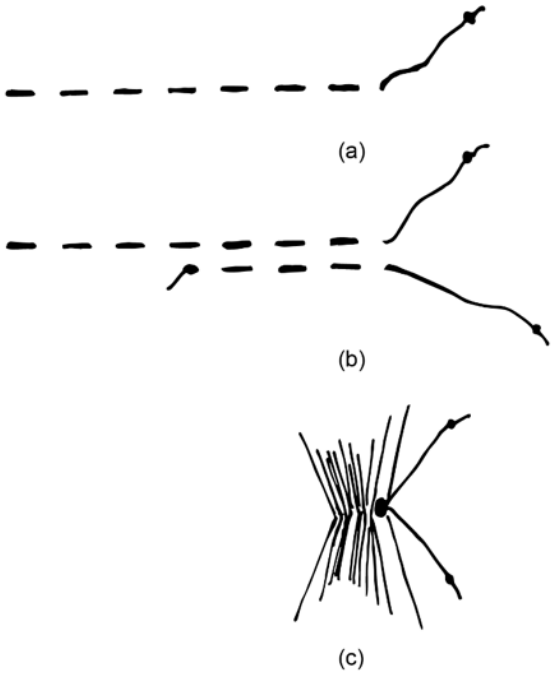


Figure 2.12 Three steps for making a false end for tying.

2.6 Colouring process in stitch-resist dyeing technique

The colouring process is conducted after the pleated fabric is securely fastened so the dyes are not able to penetrate to the resist area. The colouration process plays an essential part in producing a stitch-resist dyeing pattern. The colouring process aims to produce a contrast between the existed colours on fabric with the colour of the dyes. This stage can be conducted with one colour to create monochrome designs, or it can be repeated several times with different colour to produce multi-coloured designs (Singer & Spyrou, 1989). The colour combination can also be achieved by pulling only some sewing threads and leaving slack the rest of sewing threads on the first dyeing (Maile, 1969, p.83). The remaining loose sewing threads are tightened and fastened off before dyeing the next colour (Maile, 1969, p.83). In order to produce a multi-colour design, an understanding ofcolour combination is essential, since a multiple colouration process would overlay the initial colour and produce a new colour.

In the past, the selection of colour was limited to the availability of natural dyes in surrounded location. The limitation creates a signature colour of the traditional stitch-resist dyed cloths in a certain area. Nowadays, the option is

limitless with the multi selection from synthetic dyes and also the high accessibility to purchase any types of dyes from different locations. The selection of dyes is depended on the fibre type and determines the application of the colouring method in terms of temperature, method, equipment (Broadbent, 2001). The selection of fibre and dyes determine the success rate of stitch-resist dyeing resultant pattern. A summary of natural fibres types with the appropriate dyes is presented in Table 2.1.

Table 2.1 Type of fibres with the appropriate dyes related to it (Wells, 2000; Broadbent, 2001; Ellis, 2005; Clark, 2011).

Fibre class	Fibre name	Dye class	Dye name
Cellulose	Cotton, Linen, Hemp, Viscose (Rayon), Tencel	Reactive dyes	Procion MX, Cibacron P, Remasol, Levafix, Drimarene
		VAT dyes	Indanthrene, Indigosol
		Sulphur dyes	Sulphur dyes
		Azoic dyes	Naphthol dyes
		Direct dyes	Direct dyes
		Natural dyes	Plants and extracts
Protein	Wool, Alpaca, Mohair, Cashmere	Acid dyes	Lanaset, Washfast acid, Kiton acid
		Natural dyes	Plants and extracts
	Silk	Acid dyes	Lanaset, Washfast acid, Kiton acid
		Reactive dyes	Procion MX, Cibacron P, Remasol, Levafix, Drimarene
		VAT dyes	Indanthrene, Indigosol
		Natural dyes	Plants and extracts

The colouring application method is also equally important to ensure good colour fastness. The process of applying dyes on the fibre consists of four stages: transport of dyes to the fibre surface, adsorption of dyes on the fibre

surface, diffusion of dyes into the interior of the fibre, and fixation of dyes on the fibre (Choudhury, 2006, p.383). The application of colour on fibre can be achieved by a number of methods, such as exhaust dyeing (batch), continuous (padding) and printing (Clark, 2011). From those three methods, the exhaust dyeing (batch) is technically the most appropriate for the stitch-resist dyeing method. The exhaust dyeing process can be differentiated into hot and cold water process. The stitch-resist dyeing technique has no constraint in term of temperature, in comparison with the *batik* process that requires low-temperature dyeing process since a high-temperature dyeing process can melt the wax and ruin the resist area.

The hot water exhaust dyeing process involve a temperature gradient whereby the dyeing is inaugurated at temperature range 30 – 80°C and being increased slowly up to a final temperature; this depends on the type of dyes (Clark, 2011). In facilitating the hot water exhaust dyeing process, it is recommended to use dyeing equipment made from stainless steel that has a container big enough for all fabrics to have equal access to the dye solution (Broadbent, 2001). Thus, the dyeing processes require controlled heating to temperatures close to the normal boiling point of water (Broadbent, 2001). It is essential to control the temperature during this dyeing process, so the reaction between the dyestuff and substance in fibre can be attained.

The type of dyes for cold water dyeing are highly reactive, such as proxion MX, azoic dyes and VAT dyes (Wells, 2000). The application of azoic dyes and VAT dyes have some similarities, both applications require two stages to form the colour. One of the popular type of azoic dyes is known as naphthol dyes. This type of dyes requires at least two steps to transfer the dyestuff into the fabric. Firstly, an absorption of naphtholate ion by dipping the cloth in a salt solution; secondly, a treatment with the diazonium ion solution to bring out the colour (Broadbent, 2001). The application of azoic dyes is considered as a lengthy and difficult process. Nonetheless, azoic dyes are recognised for an excellent bright depth, in particular, the orange, red, and bordeaux hue range, which are not achievable with other dye classes (Shore, 1995). The application of VAT dyes is commonly carried out by immersing the cloth into a vat of dyes solution. The colour formation is depended into an oxidation process of the *leuco* forms of the VAT dyes (Broadbent, 2001). With VAT dyeing, the shade of a fabric is determined by how many times the cloths are dipped into the vessel and for how long (Wells, 2000). Vat dyes are one of the oldest types of dye and particularly

give dyeing on cellulosic fibres with the best overall fastness properties (Broadbent, 2001).

The hot exhaust dyeing process is usually carried out on a batch basis where some fabrics are immersed in a dye solution for a particular length of time under specific temperature (Maggs, 1990). The cold exhaust dyeing process requires no heating process, thus simpler equipment is needed and any plastic or enamel can be used as the dyeing vessels (Wells, 2000). Overall, the colouring methods of stitch-resist dyeing can be classified in two procedures: (i) immersion process of the stitched cloths into a dyeing solution; and (ii) direct application of the dyes on the stitched cloths (Brito, 2002; Ellis, 2005). The second procedure opens up an opportunity to utilise a different type of tools, such as brush, sprayer, and sponge.

For both dyeing processes, the concentration of dye solution is depended on the intended colour. It is highly recommended to follow the actual ratio so it produces a nice and even colour. The stitch-resist dyed technique was considered as a thin tying technique compare to other tie dye technique. Thus, it was recommended to employ a high concentrated dye solution with a shorter time in the dye bath, otherwise the resist areas are lost (Maile, 1969, p.80). This time adjustment should consider the possibility of producing an uneven colour.

2.7 Removing the knot process in stitch-resist dyeing technique

Revealing the knot is considered the simplest stage from the whole process. Although, it is still required an appropriate method and tool to deliver the process successfully. The most common tools to be used is a small scissor with thin blades that just sharp enough to cut the thread (Maile, 1696, p. 80). The use of very sharp scissor for cutting the sewing thread has a high risk to accidentally cut the fabric. Although, several other tools can be used to proceed this stage such as seam ripper, cutter, and thin blade (Brito, 2002). There are two recommended spots to cut the sewing thread (Brito, 2002):

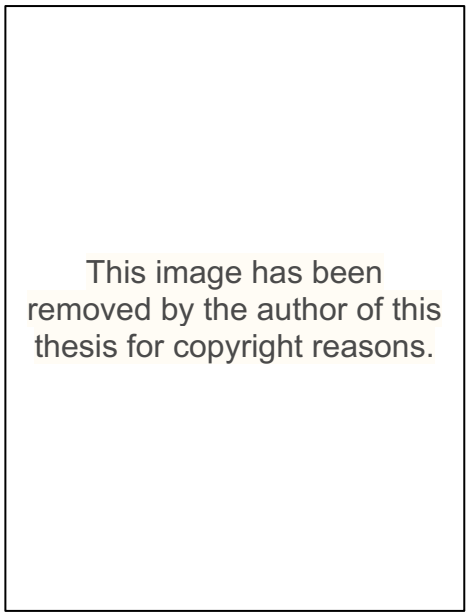
1. At the end knot on either side. Give the not a slight pull so that the blades of the scissors can slide underneath to snip it off, making sure there is no fabric being snipped at the same time.

2. At any point between pleated fabric. Part the folds of cloth until the thread is visible and cut the thread in the centre of a row of sewing. Either insert the tip of a pair of scissors and snip the thread, or better still, lever the blunt end of a needle under the small piece of taut thread, until there is enough room to insert the blade of the scissors to cut it.

2.8 Advance stitch-resist dyeing techniques

The preceding sections explained the basic of stitch-resist dyeing technique utilising the simple running stitches. This section describes chosen innovative approaches of stitch-resist dyeing technique in the 2000s. Three approaches that had been inspired by the traditional stitch-resist dyeing and then had it developed and combined with other technique. The discussion starts with the first technique, *nui-shibori* from Japan (Wada, 2002; Wada et al., 2011) that relates to the second technique, woven *shibori* (Ellis, 2005), and last technique is geometrical illuminating *tritik* (Titisari, 2012). Examining the latest developments can enrich the understanding of stitch-resist dyeing technique and the possibility to revitalise the Indonesian one.

Shibori was particularly popular during the eighteenth century (Hann, 2005) and *shibori* had changed the field of resist dyeing technique in the world since the 1990s, where before was dominated with the Malay or Indonesian term *pelangi* (Larsen in Wada, 2002). *Nui-shibori* refers to any form of stitches methods under the umbrella of *shibori* technique. *Shibori* is a traditional Japanese textile technique that utilises a variety of embellishing textiles by shaping cloth and securing it before the dyeing process (Wada, 2002). The word comes from the verb root *shiboru*, meaning to wring, squeeze or press, with an emphasis on the process of manipulating fabric (Wada, 2002); which implies to tie, fold, clamp, stitch and twist the fabric to create shaped and resisted designs. By providing both discipline and freedom in many mediums, *shibori* has the potential to transform post-industrial craftsmanship (Wada et al., 2011, p.54).



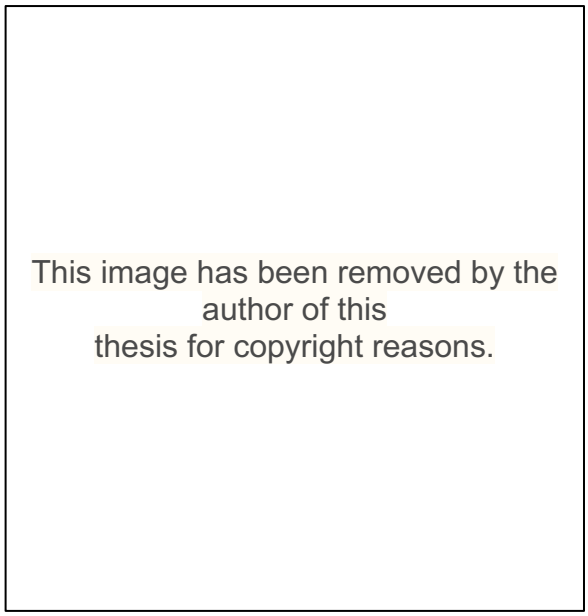


Figure 2.13 Process of creating *mokume shibori* (left) and the resultant wood grain pattern (right) (adapted from Wada, et al., 2011, p. 75).

Many well-known authentic patterns produced with *nui-shibori* technique and most of them employ similar principle with the basic stitch-resist dyeing technique explained above. However, there are two remarkable patterns among others, which are *mokume shibori* (wood grain) and *ori-nui shibori* (undulating line). *Mokume shibori* utilises many parallel lines of running stitches, creating an area or band of pattern rather than a line (Brito, 2002; Wada et al., 2011). A large area of parallel lines is required to produce the wood grain pattern, with the closer distance between lines, the better the compression (Brito, 2002). The band of pattern shows the different aesthetic from the *mokume shibori* (Figure 2.13), which usually the basic technique is constructed by lines. The *ori-nui shibori* is well-related with wavy lines pattern that fills the fabric vertically (Wada et al., 2011). The way of applying the stitches in *ori-nui shibori* is different compare to the basic one. The fabric is pinched along the pattern lines marked on the fabric before applying running stitches close to the edge of the fold (Figure 2.14). That technique produces an authentic tooth look-alike pattern along the lines (Figure 2.14), distinct with a line of dots from the basic technique.

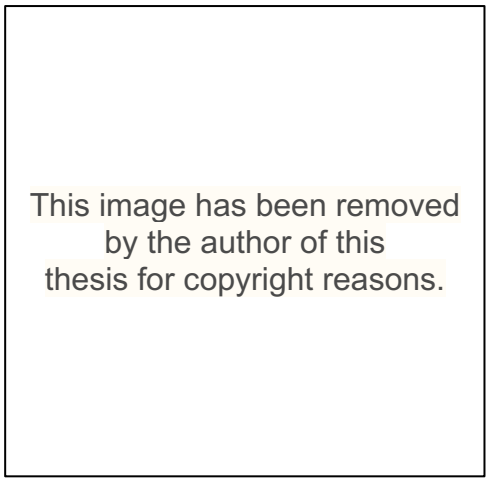


Figure 2.14 Process of creating *ori-nui shibori* (left) and the resultant *tatewaku* pattern (right) (adapted from Wada, et al., 2011, p. 76-77).

Inspired by the traditional stitched *shibori* patterns and *ikat* technique, Ellis (2005) explored the possibility to produce a new aesthetic by combining with a weaving technique, later called the woven *shibori*. The woven *shibori* technique employs a three-thread construction, consisting of ground warp, ground weft, and supplementary thread (Ellis, 2005). The supplementary thread can be added on the warp or the weft and then pulled up and knotted to produce the resist area before the dyeing process (Figure 2.15). Stitch-resist dyeing that usually comes with flexibility in drawing a figurative image on the fabric surface thus has been converted into more geometrical images according to the weaving pattern (Figure 2.16). Even through a different approach, the characteristic of stitch-resist dyeing, the small holes, is still revealed as the mark of any stitched resist pattern.

Figure 2.15 The process of adding the supplementary weft thread with a pick-up stick in the woven *shibori* method (Ellis, 2005, p.29).

Figure 2.16 Example twill weaving pattern with the woven *shibori* technique (Ellis, 2005, p. 48).

A new approach of gradual coloured dyeing processes in stitch-resist dyeing technique was explored using geometrical patterns (Titisari, 2012). The experiment was conducted on two types of fabrics: cotton and silk. The study was aimed to investigate the relation between stitch length in combination with the distance between double and triple stitch lines with the resultant patterns. A manipulated position of stitch lines was constructed in a parallel position of stitches according to square lattice and rectangular lattice, and unparallel position of stitches according to a rhombic lattice. The dots between grids were considered to the needle punctures.

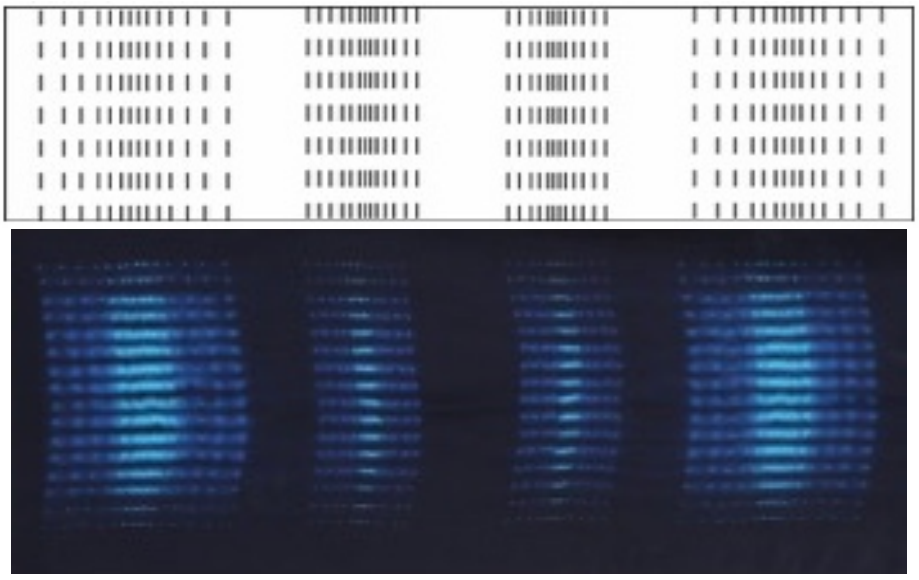


Figure 2.17 Illuminating *tritik* design (Titisari, 2012).

In result, stitch length in single line should be attained not more than 5mm to produce a clear stitch-resist dyeing pattern. In double or triple stitch lines, secondary perpendicular lines were formed in parallel position within 5-10 mm distance between stitch lines depending on the fabric thickness; thicker fabric requires less distance (Titisari, 2012). Furthermore, a design experiment was conducted by applying a gradual coloured dyeing process. Some of the lines were left slack on the first dyeing process and then tightened and fastened off before the second dyeing process. In result, a gradual colouring process in parallel stitch lines produces an illumination effect, most prominently in silk fabric. Thus, the technique was called as an illuminating *tritik*, one of the example designs is presented in Figure 2.17.

2.9 Summary

This chapter has presented an extensive review of related literature relating to the stitch-resist dyeing technique. The method has existed for an extended period and has been adopted in different locations worldwide; although, the resultant pattern on each location can be varied, depending on its stylistic tradition on adopting culture (Buhler, 1954). This chapter provides a comprehensive explanation on how to implement the traditional stitch-resist dyeing technique with some illustrations are provided on selected processes. It is explicated that the stitch-resist dyeing procedure offers more possibilities to obtain an intricate design in comparison with other physical resist dyeing methods, i.e. any resist dyeing method with a physical barrier such as tight folds or ties (Meilach, 1973; Hann and Thomson, 1993). It is because this technique provides more control over the final result than by tying and binding fabric (Singer and Spyrou, 1989). The method allows textile makers to create a variety of designs with shapes such as circles, squares, triangles, chevrons, parallel lines, lettering, floral patterns, figural motifs, or even abstract designs. Several advance application of the stitch-resist dyeing technique discussed in section 2.8 had proved the possibility to innovate the traditional method. The information provided in this chapter is fundamental for examining the Indonesian stitch-resist dyeing practices. The following chapter explains the research methodology chosen to study the Indonesian stitch-resist dyeing practices.

Chapter 3
Research methodology

This chapter discusses the research methodology employed in this study to answer the research questions and to achieve the research aims and objectives. The discussion begins with an explanation of the purpose and rationale of this study (section 3.1), and continues with a description of the research type (section 3.2). The details of the research methodology are explained in section 3.3 – 3.4 consisting of the research framework and methods in conducting this study. Section 3.5 describes the data collection and analysis processes from this study which are divided into two phases. Lastly, a summary of this chapter is presented in section 3.6.

3.1 Purpose of research

This section explains the purpose and rationale of this study. Based on the objective, there are three types of real-world research: exploratory research, descriptive research and explanatory research (Robson, 2011, p.39). The objective of exploratory research is to investigate an ill-defined area in order to generate idea/hypotheses; while descriptive research is to portray an accurate profile of persons, events or situation; and explanatory research is to explain patterns of the phenomenological aspects being researched and to identify their relationships (Kumar, 2011; Robson, 2011). The majority of real-world research conducts as exploratory research and descriptive research (Robson, 2011). In addition to the renowned research purposes, there are additional types of research purpose commonly called emancipatory or empowerment research. The focuses of both emancipatory and empowerment research purposes are to facilitate action, to make improvements and to influence policy or practice (Robson, 2011). In other words, the emancipatory or empowerment research aims to help members of an oppressed group to take control of their lives through direct action by changing or indirectly influencing policy (Brown and Strega, 2005 in Robson, 2011, p.39). Real-world research may have more than one purpose, and there is no particular rule about which one is the most suitable for the real-world research.

This research aims to understand the existing practices of stitch-resist dyeing in three locations in Indonesia, and then develop revitalisation strategies for the practices. Therefore, the purpose of this study can be categorised as an empowerment research by manifesting the three traditional research purposes: descriptive, explanatory and exploratory. In detail, the first research aim of this study has two objectives: to describe current the Indonesian stitch-resist dyeing practices and to explain the organisational structures and the technique's rigorously. The second research aim of this study is to explore the best revitalisation strategy for the Indonesian stitch-resist dyeing practices with the notion of empowerment. The project outcome is a new framework for the Indonesian stitch-resist dyeing practice that strengthens and revitalises the stitch-resist dyeing practices in Indonesia on the technical and organisational aspects. With the new approach on both aspects, an improved quality in design and production can be achieved.

3.2 Type of research methodology

The research methodology, or sometimes called 'research strategy' or 'research design', is defined as the general direction of activities to carry out the research and to analyse the data (Bryman, 2016). Kumar (2011) argued that research design is a procedural plan that is adopted by the researcher to answer questions validly, objectively, accurately and economically in the most effective and relevant way. Designing the right research methodology is very important to attain the research objectives. The three types of research described by Robson (2011) are fixed designs (quantitative research), flexible designs (qualitative research), and multi-strategy designs (absorbing both fixed and flexible elements). The key point in quantitative research is a numerical measurement of specific phenomena's aspects with a predetermined and very structured approach in formulating the relationship between variables. On the other hand, qualitative research is a more unstructured and flexible approach based on intensive study of different phenomena to build a depth of understanding (Miller and Brewer, 2003; Kumar, 2011). The last research type, a multi-strategy design type, is also known as a mixed-methods design which is a cross combination of quantitative and qualitative strategies (Bryman, 2016).

Every type of research has different strategies to accommodate the research nature. Quantitative research or fixed design has two research strategies, namely experimental strategy or non-experimental strategy. While qualitative research or flexible design has more research strategies, namely: case studies, ethnographic study, grounded theory, narrative research and participatory action research (Robson, 2011; Creswell, 2014)

3.2.1 Mixed-methods research: qualitative and quantitative

The mixed-methods research is considered as the best fitted method to meet the research objectives. Various type of mixed-methods research can be employed within the priority decision or the sequence decision as illustrated in Figure 3.1(Bryman, 2016). Bryman's chart helps to identify the weight of each method in one study and which method is preceded first in terms of data collection and analysis processes.

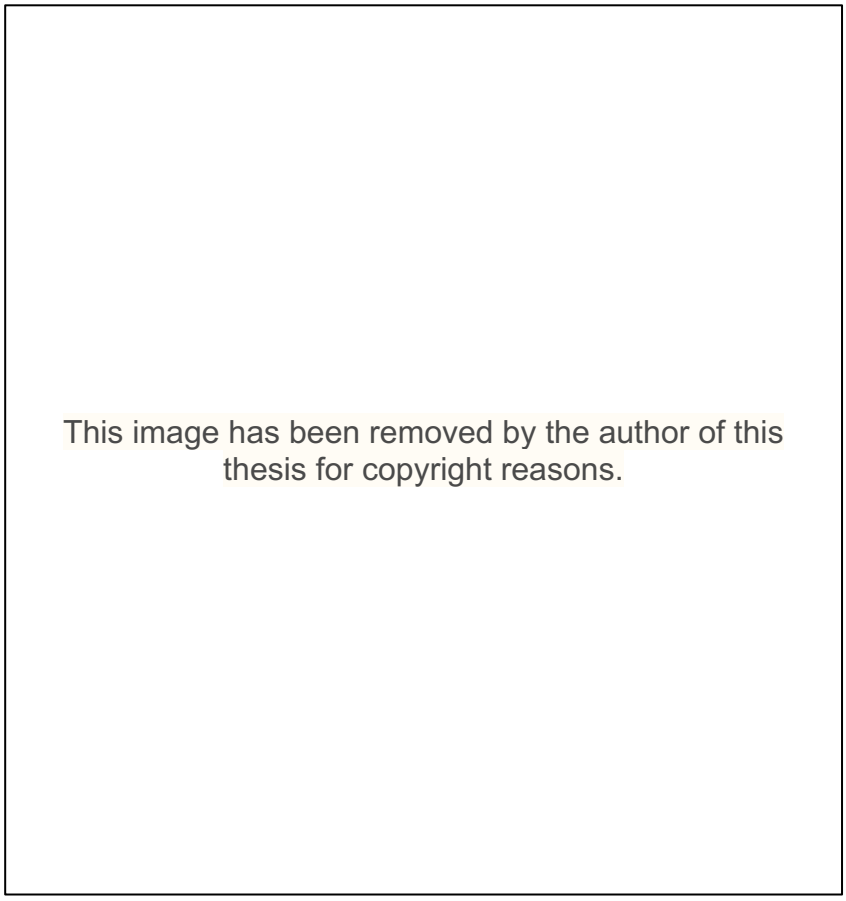


Figure 3.1 Classifying mixed-methods research regarding priority and sequence (adapted from Bryman, 2016, p. 638).

Creswell (2014) established three basic mixed-methods research which have a similar concept with Bryman's classification (Figure 3.1), and also three advanced mixed-methods research (Figure 3.2). Key points of three basic mixed-methods research are explained as follows (Creswell, 2014; Bryman, 2016). The first basic research, the convergent parallel mixed-methods, entails the simultaneous collection of quantitative and qualitative data, which typically have equal priority. The resulting analyses are then compared and merged to form an integrated whole (triangulation exercises) (Figure 3.2A). The second one, the exploratory sequential mixed-methods, requires the collection of qualitative data before the collection of quantitative data. One of the purposes is to follow up qualitative findings with quantitative research, which allows the scope and generalisability of the qualitative findings to be assessed (Figure 3.2B). The third basic research, the explanatory sequential mixed-methods, involves the collection and analysis of quantitative data followed by the collection and analysis of qualitative data to elaborate or explain the quantitative findings (Figure 3.2C).

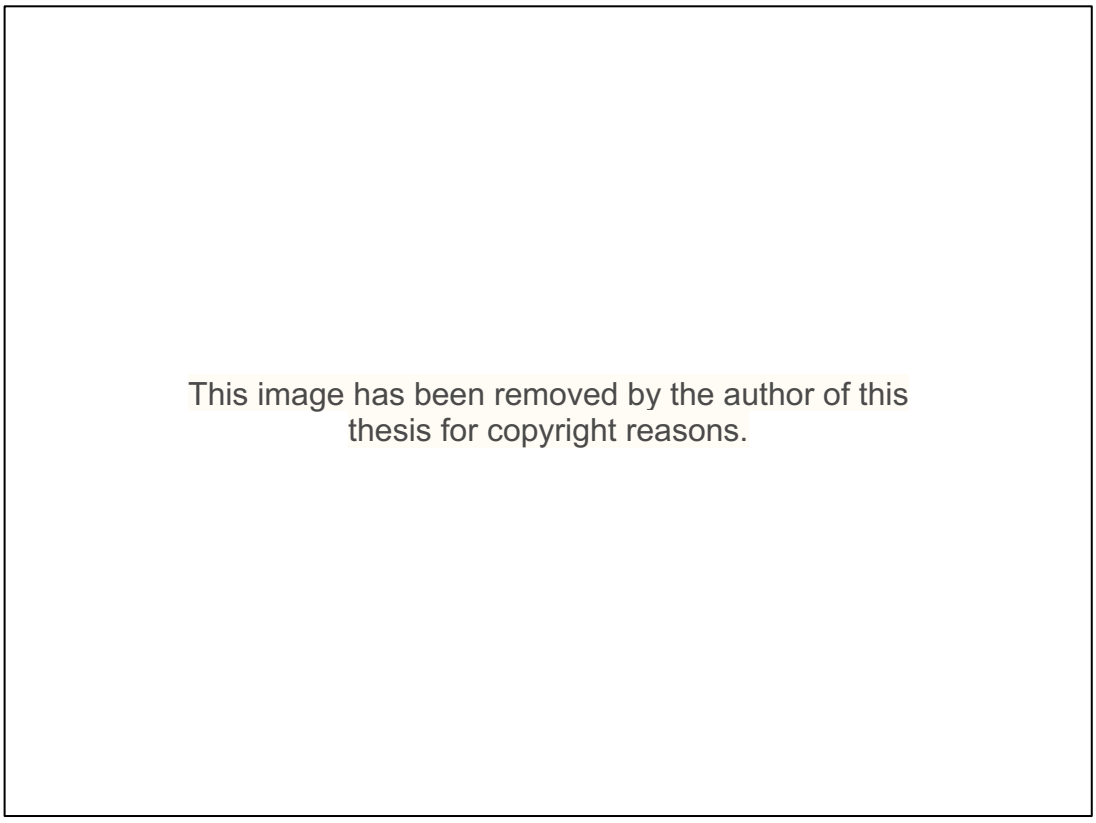


Figure 3.2 Three basic mixed-methods designs and three advanced mixed-methods designs (adapted from Creswell, 2014, pp. 220-222).

The three advanced mixed-methods research are basically an integrated variant of basic mixed-methods elements (the convergent, exploratory sequential and explanatory sequential approaches). The first advanced research, the embedded mixed-methods research, can have either quantitative or qualitative research as the priority approach, but it draws on both within a larger design such as an ethnography, a narrative study, an experiment (Figure 3.2D). The second advanced research, the transformative mixed-methods research, utilises a social justice framework to help a marginalised group (Figure 3.2E). The last advanced research, the multiphase mixed-methods research, conducts several mixed-methods projects in longitudinal study with a focus on a common objective for each project. This design is commonly employed in the evaluation or program implementation fields in which multiple phases of the project stretch over time (Figure 3.2F).

In some occasion, the mixed-methods research is associated with the bricolage approach. The term bricolage also reflects the combination of both qualitative and quantitative research strategies. Furthermore, a bricolage approach can be defined as a two-way methodological diaspora, where humanists shift to the social sciences and social scientists shift to the humanities (Kincheloe, 2001). The term ‘bricolage’ originated from French and can be referred to as ‘making-do’ in modern English phrase (Yee and Bremner, 2011). ‘Bricoleur’ as a person who employs the bricolage method, is defined as a handyman who makes use of tools and materials ‘at-hand’ to complete the task (Kincheloe, 2001). In the complexity of the human world, bricoleurs recognise the limitations of a single method and understand the necessity of new approaches of rigours in the research process (Kincheloe, 2001). Thus, with the bricolage approach, researchers are allowed to actively construct their research methods (Kincheloe, 2001) and apply a multi-methodological strategy as needed in their research (Rogers, 2012). The bricolage approach is considered as one of the research approaches that is suitable for culturally significant design research and also any design research (Yee and Bremner, 2011; Cassidy, 2018).

The choice of research methods should also consider the field of study and the research paradigm. Paradigm (or philosophical worldview) traces a general philosophical orientation about the nature of the research and an outline of research perspectives (Denzin and Lincoln, 2005; Creswell, 2014). Paradigm also leads to an appropriate methodology, questions to ask, type

of data collection and analysis. Five basic paradigms are positivism, post-positivism, critical theory, constructivism, and participatory action (Denzin and Lincoln, 2011). The social science field usually works with constructivism (often combined with interpretivism), which is also an approach to qualitative research. There are two more contemporary types of paradigms that can be employed in conducting research, namely transformative and pragmatism (Creswell, 2014). Pragmatism is not committed to one system of philosophy. It opens the door for the researcher to use multiple methods and different worldviews, as well as different forms of data collection and data analysis processes (Creswell, 2014). The perspective of pragmatism represents the characteristic of a mixed-methods and bricolage approach.

Figure 3.3 Methodological framework for the revitalisation of Indonesian stitch-resist dyeing practices study

Taking all together, this study chose the embedded mixed-methods research with bricolage approach to achieve the research aims and objectives. A

significant advantage of the embedded mixed-methods research is the feasibility to use both qualitative and quantitative methods under the bigger method, which is a multiple-case study method. Figure 3.3 shows the interconnection between each method on the framework of this study. The framework also displays the weight of the qualitative methods in this study which is greater than the quantitative one. This study requires several methods which are mainly qualitative method then followed by convergent mixed-methods to attain the research aims and objectives.

3.3 Research methodology for conducting this study

The mixed-method research methodology chosen for this study is the embedded mixed-method research; the research strategy scheme for this study is presented in Figure 3.4. The study has two research aims which are (i) to analyse the stitch-resist dyeing practices in Indonesia after commercialisation and (ii) to formulate a framework of the Indonesian stitch-resist dyeing technique that strengthens and revitalises the practice with a perspective on the cultural aspects. Therefore, the structure of this study is designed in two phases data collection and analysis with each phase accommodating each research aim. The qualitative methods is considered to be useful for examining and explaining the Indonesian stitch-resist dyeing practices in organisational structure and technique sequence. Whereas the laboratory experiment facilitates an examination of correlation between prominent factors of the Indonesian stitch-resist dyeing technique with the resultant patterns from visual perception and objective measurement. This framework also demonstrates the application of a bricolage approach because of the novel methods adapted from different fields, namely *chaine operatoire* and soft system methodology

Phase one is the embedded multiple-case studies method. The embedded multiple-case studies method was used to capture the complexity of the Indonesian stitch-resist dyeing phenomenon in three locations. The survey locations are conducted where the practices exist, namely Palembang (South Sumatra province), Yogyakarta (Special Region of Yogyakarta province), and Banjarmasin (South Kalimantan province). Each location manufactures different type of stitch-resist dyeing cloths with the same technique. Each area represents a singular case study which was embedded with multiple unit analyses, which are historical and cultural

background, technique sequence and organisational structure. The study adapts three approaches which have a specific advantage for each unit of analysis, namely an ethnography approach, *chaine operatoire* and soft systems methodology (SSM). The ethnography approach is one of the common research strategies used in the study of the communities' social and cultural life to understand the importance of local culture as the research context (LeCompte and Schensul, 1999) The use of *chaine operatoire* is to produce an analytical explanation of the technique and its sequence. The soft system methodology constructs an analysis of the organisational structure among the Indonesian craft maker communities (Davies and Ledington, 1991).

Phase two of this study is the experimental method. An experimental method is characterised by a greater control over the research environment with the researcher deliberately suggesting some change in the situation (Kothari, 2004; Robson, 2011). This method gives an advantage for examining the correlation between prominent factors of the Indonesian stitch-resist dyeing technique with the resultant patterns. Three independent variables were tested to see the effect on the resultant patterns. Those variables are tightness level, stitch properties (length and distance) and depths of shade. There were two analysis methods employed on the second phase: visual perception (qualitative and quantitative data) and objective measurement (quantitative data). The analysis of each phase were integrated to produce an analytical description of the Indonesian stitch-resist dyeing practices in three locations. Each phase has an equal weight in priority although the quantitative study in phase 2 could not be done without finishing the analysis in phase 1. The results were then used to construct an appropriate revitalisation strategy making use of the Design Routes taxonomy, which leads into designing the new framework for Indonesian stitch-resist practice. The following sections explain the description and the rationale of each selected method.

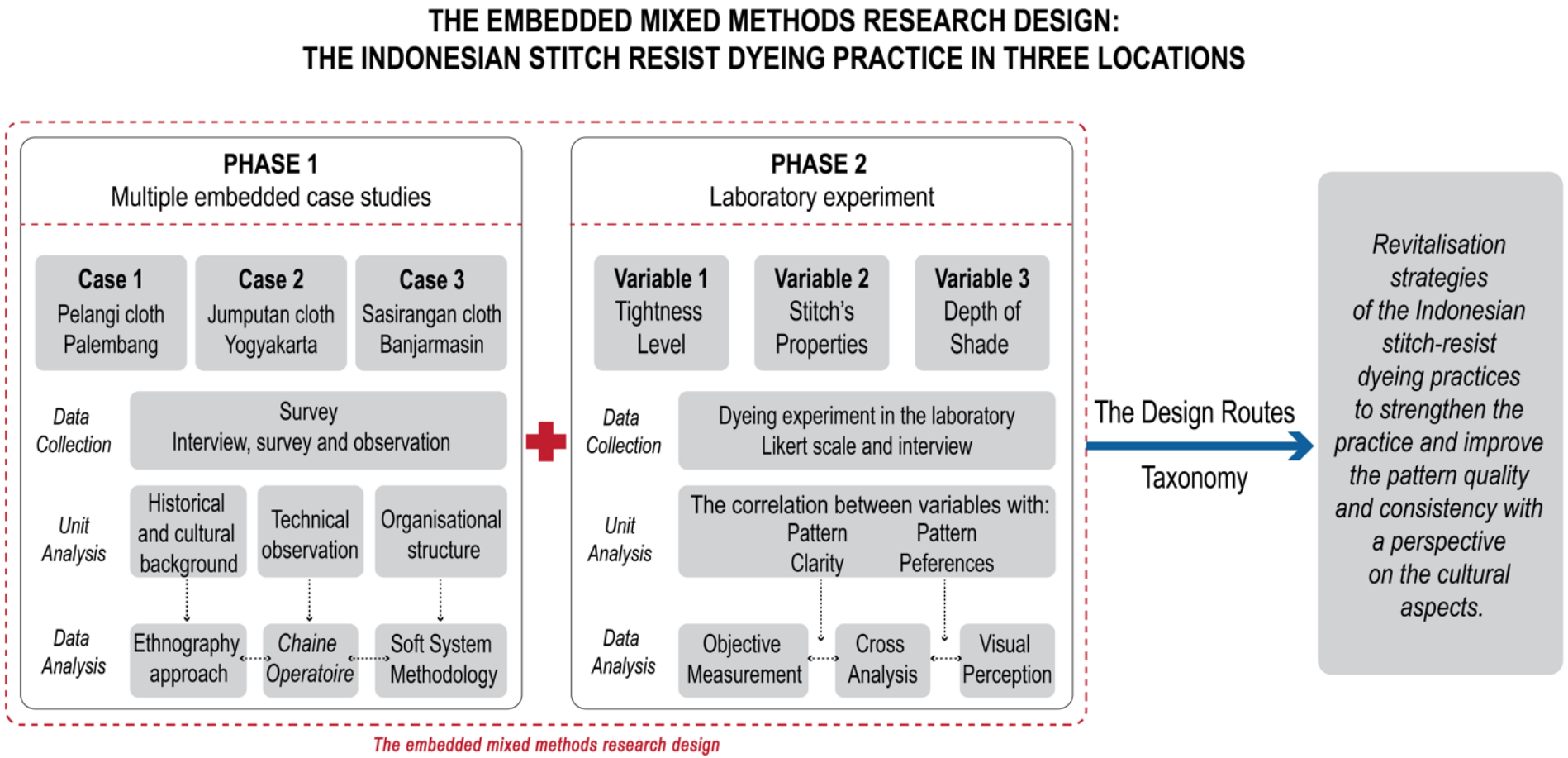


Figure 3.4 Research framework for the revitalisation strategies of Indonesian stitch-resist dyeing study.

3.3.1 Multiple-case studies

A multiple-case studies method was chosen to meet the research objectives, which are to study the stitch-resist dyeing practices in three locations in Indonesia by producing an explanatory description. The definition of case study is described by Yin (2018, p.15), as follows:

> *"A case study is an empirical inquiry that investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident.*
> *A case study inquiry copes with: the technically distinctive situation in which there will be many more variables of interest than data points, and as one result; Relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result; Benefits from the prior development of theoretical propositions to guide data collection and analysis."*

The case study method is beneficial to understand complex social phenomena that involve important contextual conditions pertinent to the case. The fact that case study includes the real-world context when examining the phenomenon makes the case study distinct from other methods. The most important application of case study is to explain the presumed causal links in real world phenomena, which are too complex for survey or experimental methods (Yin, 2018). The case studies method is generalisable to theoretical propositions and not to populations or universes (Yin, 2014). The goal of case studies is to expand and generalise theories (analytic generalisations) and not to extrapolate probabilities (statistical generalisations), or in other words, is to do a "generalising" and not a "particularising" (Yin, 2014). In this research, the stitch-resist dyeing practice in Indonesia is the case study and the context is commercialisation of traditional craft products.

The main method in the first phase of this study is a case study method (see Figure 3.4). Yin (2018) compiled four different general type of case study based on a 2 x 2 matrix which are (1) single-case holistic type; (2) single-case embedded type; (3) multiple-case holistic type; and (4) multiple-case embedded type (Figure 3.5). The matrix shows that every type of case study consists of contextual issue relating to the case. The matrix also shows that each case, either single-case or multiple-case, can be unitary or multiple units of analysis (Yin, 2018). Overall, the single-case study usually represents (a) a critical test of existing theory, (b) a rare or unique circumstance, or (c) a representative or typical case, or where the case

serves a (d) revelatory or (e) longitudinal purpose (Yin, 2018). Within the single case may still be incorporated subunits of analyses which often add significant opportunities for extensive analysis, enhancing the insights into the single case. The multiple-case research should do a replication on each case, not a sampling logic (Yin, 2018). The cases should serve multiple experiments with similar results or contrasting results predicted explicitly at the outset of the investigation (Yin, 2018).

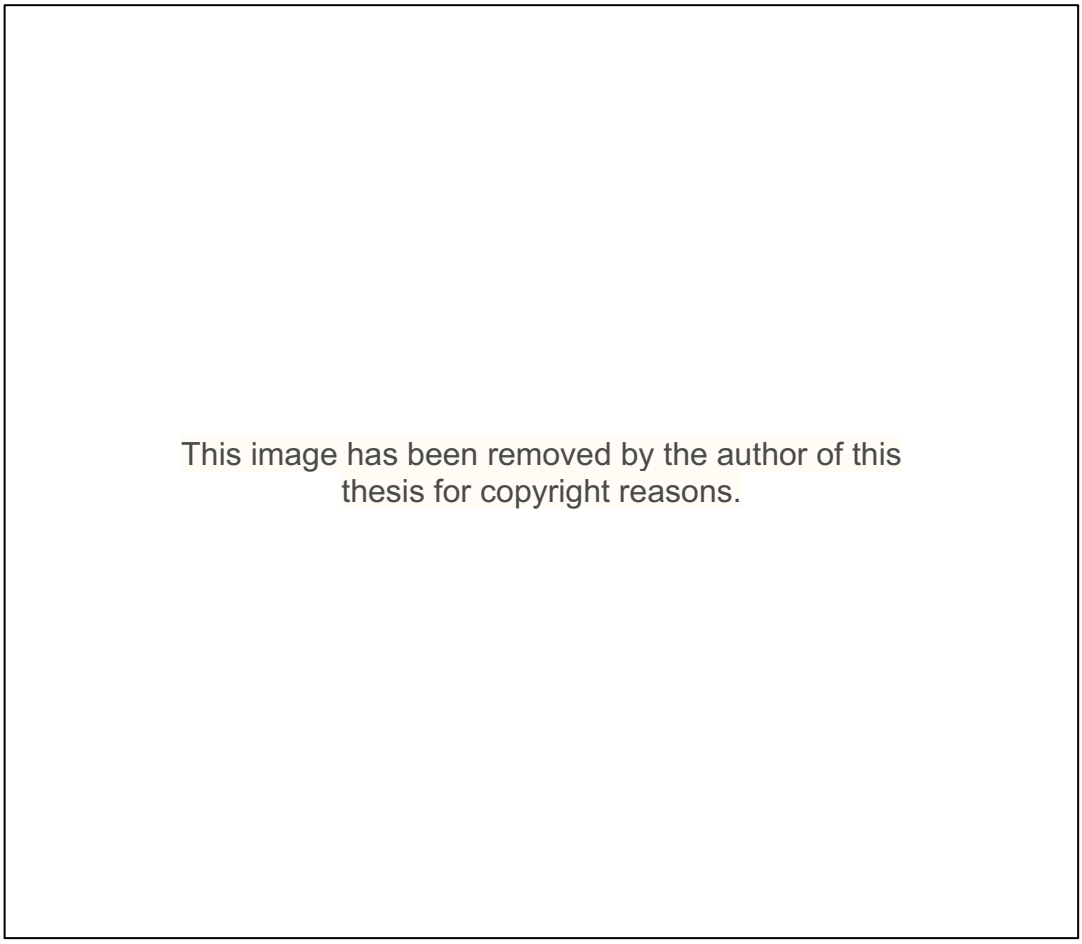


Figure 3.5 Basic types of designs for case studies (adapted from Yin, 2018, p.48).

The embedded multiple-case study was adopted to analyse the situations and problems that might occur in the Indonesian stitch-resist dyeing practices. In this study, three locations in Indonesia, namely Palembang (South Sumatra Province), Yogyakarta (Special Region of Yogyakarta Province) and Banjarmasin (South Kalimantan province) were chosen as the

case studies (see Figure 3.9). The stitch-resist dyeing technique is commonly used by craft makers in many areas in Indonesia. This study focuses only at the use of Indonesian stitch-resist dyeing practice as a craft industry, which means the craft makers produce the cloths in a large quantity and for commercial purposes. The three locations were chosen based on literature studies and also data from The Indonesian Department of Industry and Commerce. Those three locations have been manufacturing of long-established traditional cloths and also have numerous small or medium enterprises registered in the local Department of Industry and Commerce. Each location was analysed as a single case study within the same unit analysis. This study focuses on three units analysis for each case, which are historical and cultural background, technical observation and organisational structure.

There are five analytical techniques established by Yin (2014): (i) pattern matching; (ii) explanation building; (iii) time-series analysis; (iv) logic models; (iv) cross-case synthesis. The first technique (pattern matching) examines the pattern of non-equivalent dependent variables or rival independent variables within each case. The second technique (explanation building) analyses the case by building a general explanation that fits a single case study or individual case in multiple-case study. The third technique (time-series analysis) examines the relationship of events over time. The fourth technique is beneficial in doing case study evaluations and in studying theories of change by stipulates and operationalises a complex chain of events over an extended period. The last technique (cross-case synthesis) analyses the comparison of commonalities and differences within units of analysis in each case (Yin, 2014). This study employed the cross-case synthesis as the main analytical technique which also includes an explanation building and logic models. The analysis process was a linear but iterative process, looking at all sources which were survey interview, direct observations, physical artefacts and documentation.

3.3.2 Ethnography approach

Ethnography methodology is adopted as an approach in this embedded multiple-case studies. This approach is particularly useful in studying and gaining best understanding about the cultural significance of the stitch-resist dyeing practice among the Indonesian craft-makers. Ethnography

methodologies can be used for problem identification and solving or as a way of creating theories of culture (LeCompte and Schensul, 1999). In this research, ethnography approach is employed to identify the problems and possible solutions in stitch-resist dyeing among Indonesian craft-makers. It is essential to understand the culture of the craft makers community because the explanation of the technique cannot be separated from the maker's cultural life. In addition, the new framework should be adjusted with the existing community's culture for sustaining the culture.

Ethnography is best described as a research strategy to understand and study the meaning of social structure and cultural life in naturally occurring settings or fields; it produces a description and interpretation of the ways of life of people, social groups or communities (LeCompte and Schensul, 1999; Brewer, 2000; Miller and Brewer, 2003; Robson, 2011). Ethnography studies are more focused on the interplay of variables in the natural context, in contrast to quantitative studies that are based on examining variables in controlled situations one at a time (Newman and Benz, 1998). In this methodology, the ethnographer observes and records directly the social interaction as an ongoing process in the field without imposing on them (Newman and Benz, 1998; Miller and Brewer, 2003). The best position of the researcher in field settings is as an "invited guest" to learn what people do and the reasons they give for doing it (LeCompte and Schensul, 1999). There are seven characteristics of an ethnographic study (LeCompte and Schensul, 1999), as follows:

1. Carried out in a natural setting, not in a laboratory
2. Involves intimate, face-to-face interaction with participants
3. Presents an accurate reflection of participants perspectives and behaviours
4. Uses inductive, interactive, and recursive data collection and analytic strategies to build local cultural theories
5. Uses multiple data sources, including both quantitative and qualitative data
6. Frames all human behaviour and belief within a socio-political and historical context
7. Uses the concept of culture as a lens through which to interpret results

Ethnography strategy starts with conducting an initial qualitative or exploratory research to find out what is happening in a particular scene then

deciding which key variables and domains should be investigated quantitatively, to verify qualitative findings and to improve the generalizability of initial findings to the whole community (LeCompte and Schensul, 1999). Schensul (1998-1999, cited in LeCompte, 1999) explained the recursive process involved in the cyclical nature of this type of analysis, moving back and forth between inductive analysis – which uses specific items to build more general explanatory statements - and deductive analysis – which applies general explanatory statements to groups of specific items. Glauser and Strauss (1967, cited in LeCompte and Schencul, 1999) denominated these recursive processes as grounded theory. Meanwhile, Spradley (1979, cited in LeCompte and Schencul, 1999) refers to domain and structural analysis. In this respect, the ethnography strategy starts with hunches, guesses, initial hypotheses, models, and concepts that are interesting and related to the research problem then investigated with participant observations, interviews, and personal documents as discourse analyses (LeCompte and Schensul, 1999; Brewer, 2000). Ethnography methodology is fitting for answering the research questions. Although, the main disadvantage of the ethnography method is that it requires a researcher to stay and immerse him/herself with the participants in a long period of time. That point has become the limitation of this study. Thus, ethnography constitutes only part of the embedded multiple-case studies methodology.

3.3.3 *Chaine operatoire*

Records on how to conduct the stitch-resist dyeing technique, especially in Indonesia, are considered to be insufficient. Some literature covered the basic description, although the information is not sufficient enough to analyse the technique. In this study, *chaine operatoire* has been adapted as a supplement to the ethnographic study of Indonesian stitch-resist dyeing practice with focus on the technical aspects. The application of this method plays a vital role in addressing the paucity of information about the technique sequence.

Mostly used by French archaeologists, the word *chaine operatoire* is a French term which translates as an operational chain or sequence (Schlanger, 2005). The *chaine operatoire* has been initially used to analyse the process of tool manufacture in archaeology, mostly in lithic technology. The process consists of selecting, shaping and transforming raw materials

into a valuable artefact that occurs naturally (Sellet, 1993; Schlanger, 2005). Later, the use of *chaine operatoire* as a method has become more comprehensive, encompassing a broad range of archaeological materials and problem areas (Lemonnier, 1992; Torres, 2002; Schlanger, 2005). Later in 1990s, a concept of the ethnology of technology was introduced creating a new focus of *chaine operatoire* as a method to examine a social construction and technological knowledge (Lemonnier, 1992). This concept also emphasises the importance of analysing the technological traits not only for their physical aspects but also the way they are made and used. Lemonnier (1992) proposed the idea that every technique has five related components to be considered: matter, energy, objects, gestures and specific knowledge. In the same vein, a study of the *chaine operatoire* by (Torres, 2002) also developed a new focus of *chaine operatoire* on the operational sequence as a socially embedded reality that deals other dimensions of the study: environment, economy and subsistence, social organisation, culture and beliefs, political organisation and technological knowledge. Those dimensions are considered as the width approach of the *chaine operatoire* interlinked with the length of the sequence of analysis process (Figure 3.6).

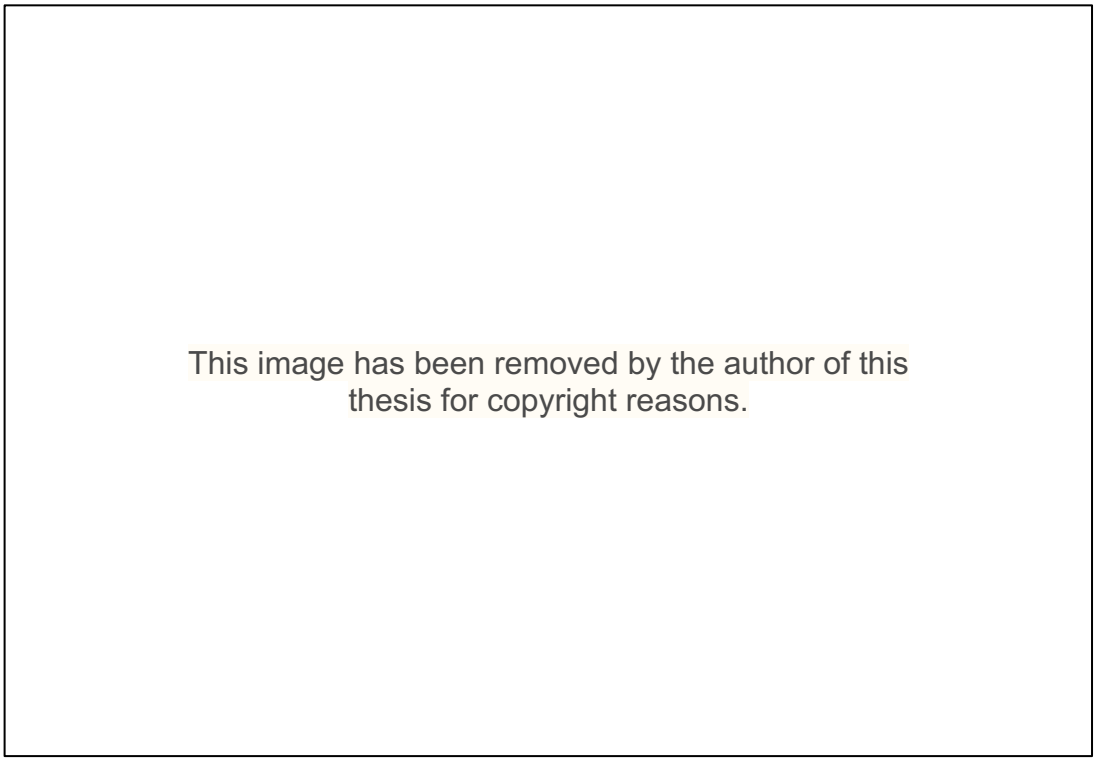


Figure 3.6 Diagram with representation of the length and the width dimension of the *chaine operatoire* (adapted from Martinon-Torres, 2002).

The objective of this particular observation is to examine the Indonesian stitch-resist dyeing technique sequences by identifying the differences and the similarities of them in three stitch-resist dyeing locations in Indonesia. The stitch-resist dyeing technique in Indonesia involves a complex sequence of operations which needs to be examined at each stage, in order to produce specific and systematic information about the technique. The analysis process was undertaken firstly by creating a categorisation and then by comparing each category. The creation of the classification was a dialectical process based on the collected data: transcriptions, images, voice records, observation notes and videos. After creating categories from the data, a comparison analysis was conducted by creating graphics.

3.3.4 Soft System Methodology (SSM)

Soft System Methodology is a system thinking that analyses human activity as a soft system analysis where the problems could exist (Checkland and Scholes, 1990; Patching, 1990). In comparison, hard systems analysis addresses parts of an organisation that have a tangible form, e.g. the structure, the level of staff, equipment usage (Patching, 1990). This methodology was first developed by Checkland and Scholes (1990) to encounter user problems by the computer hardware industry but then it became popular in the design research field since early in the 2000s (Cassidy, 2018). This system is considered to be very useful in the revitalisation of culturally significant products and practices research area (Cassidy, 2018). The main object of this study, Indonesian stitch-resist dyeing craft practices, is considered as culturally significant products and practices, and involved of human activities. SSM was applied in this study to undertake an analysis of organisational systems among the Indonesian stitch-resist dyeing craft-makers. The practice has been transformed into a craft industry model and it has become a communal work which involves numerous craft makers working as a system.

The first SSM model was introduced with seven stages by (Checkland and Scholes, 1990) and it has been developed by Patching (1990) and Davies and Ledington (1991) (Figure 3.7). The seven-stage model draws a line that makes a distinction between real–world activities which are related directly to the problem situation and the systems world where the analyst withdraws

from the examination of the real situation and objectively considers relevant systems models (Patching, 1990).

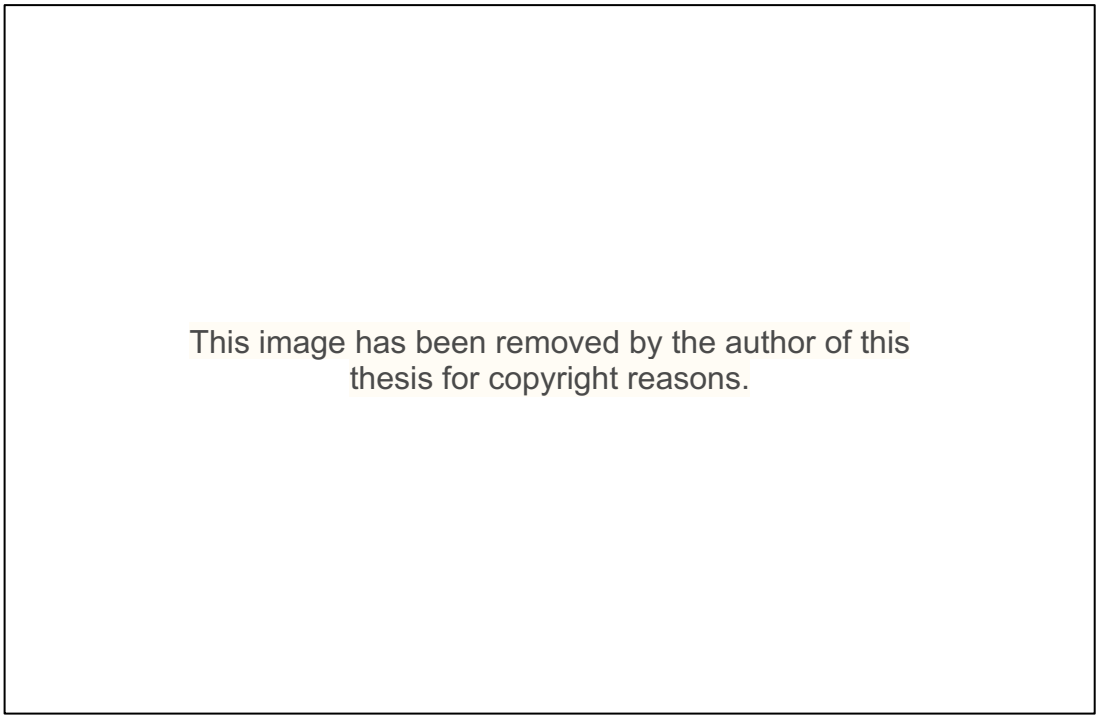


Figure 3.7 The seven stage models diagram from SSM (adapted and expanded from Patching, 1990, p.41-42).

Stages 1 and 2 are used for expressing an unstructured situation in the real world (Patching, 1990). A lot of information is collected about things as organisation structures, the number of people involved, processes, locations, etc together with the views of individuals and the prevailing issues (Patching, 1990). In practice, the analyst is interviewing, observing, reading-up on background material, deciding about making changes during the later stages, and how these can be implemented (Checkland and Scholes, 1990). In the second stage, this situation is expressed pictorially using a device known as a rich picture (i.e. drawing pictures, diagrams, taking notes, and writing prose) (Patching, 1990; Davies and Ledington, 1991). The reason for using rich pictures is because human activities involve rich relationships around the circumstances being examined (Checkland and Scholes, 1990). The picture highlights issues relevant to subsequent system models. Once an acceptable rich picture has been constructed, the investigation

temporarily leaves the real world and enters the systems thinking phase (Patching, 1990).

Stages 3 and 4 are part of forming the root definition and conceptual modelling (Checkland and Scholes, 1990). This part defines the design solution as a hypothesis and whether it is feasible to apply the solution later to the community (Cassidy, 2018). Analysis of SSM can take part in role level or cultural level (Davies and Ledington, 1991). In constructing the root definition, understanding of the culture of the situation needs to be gained through developing and understanding of the problem situation (Davies and Ledington, 1991). Attributes of culture are explained by Davies and Ledington (1991) as history, contingency, symbolic forms, formalisms, and behaviours. The mnemonic CATWOE is used as a checklist to help ensure that all the necessary components are present in the root definition (Patching, 1990; Cassidy, 2018). CATWOE is constructed from:

- C = Clients or customers: who benefits or are affected by, the outputs from the system.
- A = Actors or agents: who carry out the activities within the system and facilitates its operation.
- T = Transformations: how is the system transformed (i.e. the conversion of the input to output)
- W = *Weltanshaung* or Worldview: how the system is perceived from a particular (explicit) viewpoint – sometimes described as ‘assumptions made about the system’
- O = Owners: who control the system or could cause it ceases to exist.
- E = Environment: how the surrounds influence the system but has no control over it.

The three final stages of SSM model are more applicable to business systems but can be applied some design problems cases (Cassidy, 2018). Although SSM is a seven-stage process, any of the stages and or method/tools within those stages can be used individually by researchers depending on the needs and context of their study (Checkland and Scholes, 1990; Patching, 1990). The first four stages was employed for this study in order to create the new framework as conceptual models (stage 4).

3.3.5 Laboratory experiments

The second phase of this research consisted of an experimental study which was conducted in the laboratory. The experimental approach is characterised by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables (Kothari, 2004). In contrast with ethnography approach use in phase one, procedures and variables in fixed design need to be specified in advance and based on well-articulated theory about the phenomenon that is being researched (Robson, 2011). The fundamental theory in designing this experiment was taken from the survey data plus literature studies. The quantitative strategy was adopted in this study to examine the correlation between prominent factors of the Indonesian stitch-resist dyeing technique with the resultant patterns. This test employs three independent variables in this test, which are tightness level, stitches properties (length and distance) and depths of shade. The material and colouring methods are the constant variables, where the resultant patterns are the dependant variables. The patterns were examined for their clarity and preferences both by a visual perception method with structured interviews and by objective measurement with the graphic processing programme (MATLAB). Further explanations of this method are described in sections 3.5.3 – 3.5.4.

3.4 Design Routes taxonomy as revitalisation strategies

Revitalisation is the attempt to sustain or transform the existence of culturally significant design, products, and practices (Cassidy, 2018). The revitalising and transforming process can be pursued by maintaining the tradition in its original form or creating a new form from a particular tradition to fit into contemporary lifestyles (Nugraha, 2018). A number of studies have developed a variety of approaches relevant to culturally significant designs, product and processes. The Design Routes taxonomy was adopted in this study as a tool to analyse the most appropriate revitalisation strategy for the Indonesian stitch-resist dyeing case studies. This approach suggests a preliminary study of creative ecology where the craft makers operate. Creative ecology is defined as the context and culture within which the culturally significant design, products and processes exist. The level of success in applying the revitalisation strategy relies on the level of understanding of the creative ecology of each example. The embedded

multiple-case studies method is considered as a perfect tool to attain a good understanding about the creative ecology of Indonesian stitch-resist dyeing practices.

The Design Routes taxonomy consists of eight clusters of revitalisation strategies to connect traditions, values and beliefs with the needs of people in the modern world (Evans et al., 2018). Those revitalisation strategies are interconnected and interdependent which means they can be applied independently or dependently (Figure 3.8). Those eight clusters are identified as (i) Sustained through design: combined traditional making or use practice with new or reimagined design; (ii) Transpose tradition: take traditional design or making practice into a new context; (iii) Value of place: foreground the value of place and provenance; (iv) Production processes: employ appropriate and effective methods of making; (v) Skills: employ targeted approaches to embed and enhance skills; (vi) Promotion: spread awareness and appreciation via effective promotion; (vii) Enterprise: employ effective business, organisation, and finance models; and (viii) Research and education: learn about traditions, meanings, and contemporary relevance.

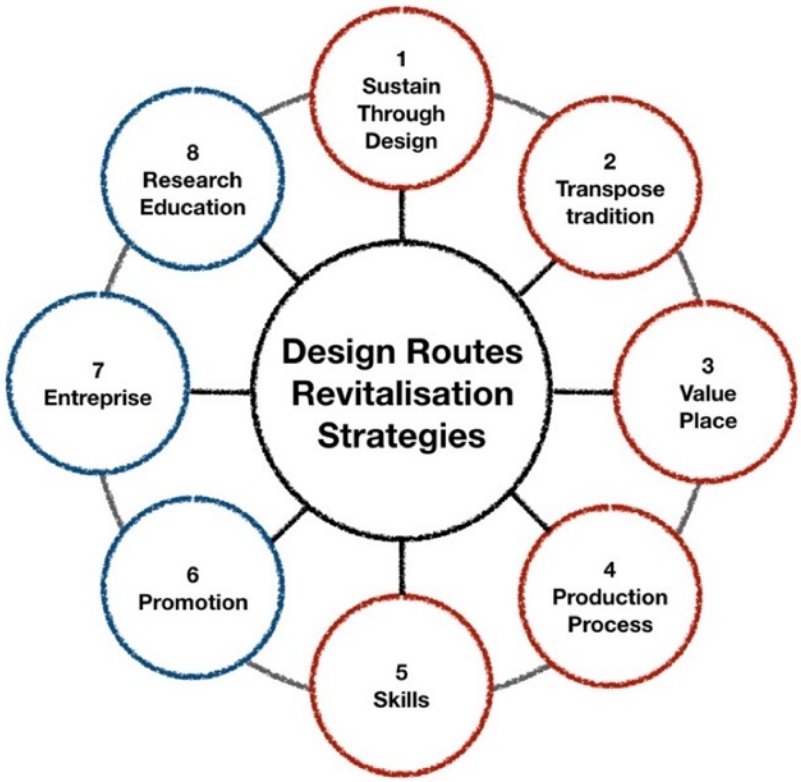


Figure 3.8 Eight Design routes revitalisation strategies (Evans et al., 2018).

The first until fifth clusters mentioned above are the primary clusters (red circles on Figure 3.8) for revitalising culturally significant design, products and processes. Whereas the last three clusters (i.e. promotion, enterprise, research and education) are the supplementary clusters (blue circles on Figure 3.8) that can support and underpin how design can reconnect traditions, values and beliefs with modern lifestyle. Each cluster covers a wide group of strategies. Each strategy is further divided into sub-clusters which address more specific strategies. This study focuses on examining the five primary clusters for the Indonesian stitch-resist dyeing practice based on the case studies' findings. Although, in practice, the three supplementary clusters are entangled with the primary clusters. The selection of the appropriate revitalisation strategy is crucial to ensure maximum benefit for the community, in this case, the Indonesian stitch-resist dyeing crafts makers.

3.5 Data collection and analysis methods

Previous sections have explained the research type and methods that were adopted in this study. This section describes the procedure for collecting and analysing data in each phase consecutively. The techniques used for collecting data can be specific, general, single or multiple instruments (Bryman, 2016). Even though phase one has multiple methodologies, all of them recommended a similar technique and instrument in collecting the data. The process of data collection was conducted under a multiple-case study procedure, such as direct observations, survey interviews, documentations, semi-structured interviews and observing the physical artefacts. Afterward, the analysis method was conducted with mixed approaches.

The second phase of this study was the experiments (fixed design). The data collection was held in the laboratory. Several dyeing experiments were conducted to produce sufficient samples of stitch-resist dyed fabric with different patterns. After that, the samples were analysed with a convergent parallel mixed-method, which means the analysis process used both the quantitative methods (objective measurement) and qualitative method (visual perception), see section 3.1. Both results were compared and merged to form an integrated whole as a triangulation exercise (Creswell, 2014, p.220). The following sections describe the process in detail.

3.5.1 Data collection phase 1: Embedded multiple-case studies

This phase employed the embedded multiple-case study method with an ethnographic approach, *chaine operatoire* and soft systems methodology (SSM). The objective for this phase was to analyse the current stitch-resist dyeing practices in Indonesia after the craft commercialisation in three selected areas. There are three units of analysis: (i) historical and cultural background; (ii) technical observation; (iii) organisational structure.

The data collection was an iterative process and it was divided into two stages. The first data collection was conducted to explore the components of the Indonesian stitch-resist dyeing practices. The focus was to understand the process employed in each location, focusing on which type of materials are usually used, what kind of technology is adopted and how the production flows between the Indonesian stitch-resist dyeing makers. The cultural behaviour and social structure among the craft makers - who produce the cloths as their daily routine – were also investigated. The methods used in this stage were direct observation, survey interview, documentations, and artefacts. Survey interviews is a type of interview that uses a questionnaire (Yin, 2014). The benefits of using survey interviews are both quantitative and qualitative data are gathered at the same time and in a shorter duration. A simple questionnaire was designed based on findings from the literature review (Appendix A3). The other purpose of using a questionnaire was to get numerical data about Indonesian stitch-resist dyeing practices. As a preparation for the fieldwork, an ethical review application form, and a fieldwork assessment form for low-risk activities were submitted and have been approved by the University of Leeds Research Ethics Committee (PVAR 16-001).

The first stage data collection was conducted in three locations of stitch-resist dyeing production in Indonesia, which are Yogyakarta - Special Region of Yogyakarta Province, Palembang - South Sumatra Province, and Banjarmasin - South Kalimantan Province. Each of the stitch-resist dyeing production areas lies in a different island in Indonesia (Figure 3.9). Each location also has different ethnic group with their own culture.

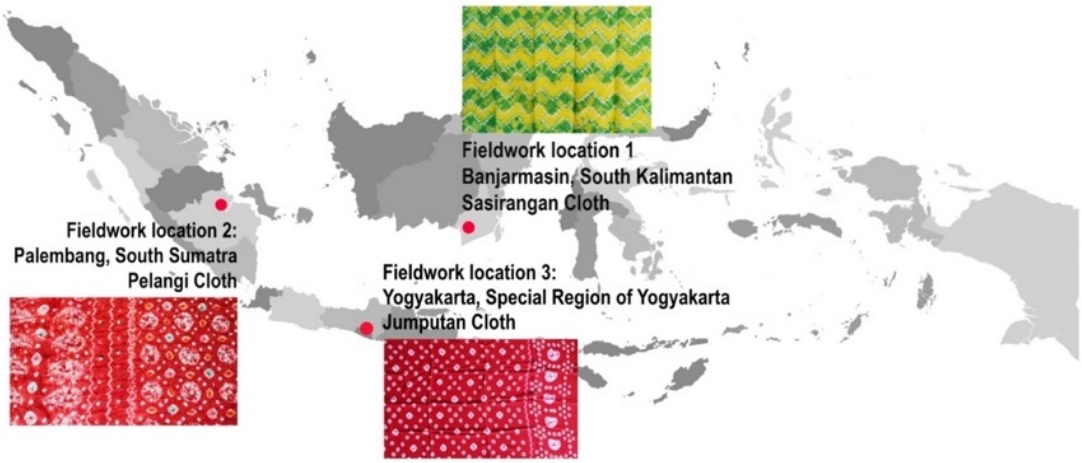


Figure 3.9 Map of survey locations of the Indonesian stitch-resist dyeing.

Data collected from the Indonesian Department of Industry and Commerce (Disperindag) in March 2016 were used as a guidance to recruit the potential respondents for participating in this study. With help from the staff Disperindag in contacting the respondents, the potential participants were approached by asking in person via phone or text message. They were first approached and informed about the research and then being asked to make an appointment for further explanation if they were interested in participating. The interested respondents were arranged to be visited by the researchers based on a timetable. Meanwhile, other respondents were recruited during the survey. All potential participants were given the information sheet of this research (Appendix A1) and were allowed to ask some questions. Their participation was voluntary and participants were assured that they could leave at any time without giving any explanation or justifying their decision.

The survey started with asking the respondents to fill the consent form (Appendix A2) to be part of this study and then the survey continued with the survey questionnaire method. The researcher asked and filled each point of the questionnaire based on their answers with their agreement. An interview or discussion followed at each point where the participant had the opportunity to explain their answer. All the answers were audio recorded to ensure the validity of the research. An observation method was used during and after the interview by taking notes and photographs of important points to generate data on the cultural life of Indonesian stitch-resist dyeing makers in a natural situation. The entire survey activities on three locations were

accomplished in one month and fifty seven of respondents were participated in the first stage.

The result from the first stage fulfilled some of the research objectives, although information about the process was still inadequate. With the time limitation to study three locations, the first survey captured the general idea about Indonesian stitch-resist dyeing practices in each area but not the detail of each process. Therefore, a more rigorous and in-depth inquiries on the process were required to identify critical aspects of the process that need to be developed to reinvigorate the technique. These aspects were important to determine the second phase of the study's framework which employs the experimentation approach.

The area of the second data collection was narrowed into one location, which was Banjarmasin in South Kalimantan province. Banjarmasin was chosen because it has the highest production capacity and active initiatives in design and technology sectors from the craft makers, based on the initial analysis. Nonetheless, the findings from the first data collection about the stitch-resist dyeing practices in Yogyakarta and Palembang remain significant for comparative study with the stitch-resist dyeing practices in Banjarmasin.

The second data collection was conducted to obtain detail of each sequence of the stitch-resist dyeing practice in Banjarmasin. The main focus of the second inquiry was to identify and select the critical aspects of the process that need to be studied further in order to reinvigorate the technique. This survey applied an in-depth interview method and a participant observation method with a total of twenty respondents. The second data collection was started with asking the respondents to fill the consent form to be part of this study. During the interview process, all answers were audio recorded to ensure the validity of the research. The participants were observed during the process of stitch-resist dyeing in the natural situation. Some of the participants preferred to have an interview while doing the stitch-resist dyeing process. Photographs and notes of important points from each step of the stitch-resist dyeing technique were taken during the second data collection process. To gain more information about the process, craft makers who have a role in technical aspects such as – the stitcher, the drafter, and the dyer - were prioritised. However, some craft makers were also important informants who capable to explain historical and aesthetic aspects of

Sasirangan cloths. Thus, that aspects were also identified during the interview process.

3.5.2 Data analysis phase 1: Cross-case analysis

The total number of participants involved in the first and second data collections was seventy-seven participants with different roles. Details of roles are provided in Appendix B1. Data analysis for this phase was based on numerical data from questionnaire; the interviews transcripts from audio recording (sample is provided in Appendix B2); notes, photos and videos documentations from observation; and examinations of the physical artefacts (i.e. the traditional cloths from each location). All data was merged then coded to establish the similarities and differences between each location on the cultural and historical background, technical aspects and organisational structures. Explanation of each unit of analysis is described as follows:

1. An explanatory description about the cultural and historical background of each location was produced which included building of the analytic strategy. In a multiple-case study, one goal is to build a general explanation that fits each case, even though the cases are varied in their details (Yin, 2014). An initial explanatory proposition was constructed from each location then compared with the other locations.
2. An analytical explanation of the Indonesian stitch-resist dyeing technique sequence in three locations was constructed using *chaine operatoire* methodology. This method helped to illustrate each sequence of the process by each craft maker, also the culturally significant aspects from different craft makers. The result of this analysis was formed as a diagram and an illustration of each sequence, along with the narrative explanation. The process was applied on individual area and then the results were compared using cross-case synthesis analytic strategy.
3. An examination of the organisational structure of the stitch-resist dyeing practices in three areas was followed the SSM model. The role definition was defined by reference to the CATWOE guidance and then a rich picture of the organisational structure was produced. The process was applied on individual locations and then compared using a cross-case synthesis analytic strategy. The characteristic of each

organisation was compared, and the advantages and disadvantages of each organisation were explained.

3.5.3 Data collection phase 2: Laboratory experiments

The experimental plan in the second phase was based on findings from the first phase. The analytical description about the technique (i.e. *chaine operatoire* sequence) was the main foundation in designing the experiment, although the explanation about the culture and organisational structure were also beneficial in deciding the variables of experiment. The aim of this phase was to examine the correlation between prominent factors of the Indonesian stitch-resist dyeing technique with the resultant patterns. The experimentation method was conducted with quantitative methodology to gather an objective measurement of the prominent factors. Although some limitations were still existed since some of the processes (i.e. knotting process, marking the knot distance) were conducted manually. The quantitative methodology used in this phase was comparative design research experimentation, comparing two or more variables with different manipulation in producing stitch-resist dyeing pattern. A pilot experiment was carried out before the main experiment to sort out technical matters related to the data collection methods.

Based on the explanation in chapter 2, there are five factors that could affect the stitch-resist dyeing resultant pattern, as follows: (1) selection of material: fabric, thread number, needle size; (2) selection of dyes and colouring method; (3) depths of shade; (4) stitch length and distance; and (5) tightness of the knot. The experiment was focused on the correlation between three variables on the stitch-resist dyeing technique which are depths of shade, tightness level and stitch properties (stitch length and stitch distances) and the resultant patterns. An outline of the experiment variables are described in Table 3.1 and the outline of each sample is illustrated in Figure 3.10.

All the variables in this experiment were kept in line with Indonesian technique, in terms of material selection (fabric, thread, dyes) and procedure (sewing and knotting technique, sequence). The detailed procedure for determining the tightness level is presented in section 5.1.2. The experiment was conducted by the exhaust dyeing process with Remazol Black B (C.I. Reactive Black 5), producing blue shades. Blue was chosen to produce the best contrast with the initial fabric colour. Many Indonesian craft makers

utilise reactive dyes as one of their colouring methods. The dyeing process was carried out using a Roaches Pyrotec 2000 series infra-red dyeing machine and detail of the dyeing procedure is described in Figure 5.2.

Table 3.1 Variables of dyeing experiment.

No	Variable	Stitch-resist dyeing factors		Specification
1	Dependent variable	Pattern clarity		A definition of stitch-resist dyeing pattern that perceivable
2	Independent variable	Colour shades	Colour depth	1% depth of shade 2% depth of shade 3% depth of shade
3	Independent variable	Stitch properties	Stitch length (stitch distance)	3mm (3mm); 5mm (5mm)
4	Independent variable	Tightness level between the two knots	High (Tight)	50% of the number of pleats multiplied by fabric thickness
			Medium (Moderate)	75% of the number of pleats multiplied by fabric thickness
			Low (Loose)	100% of the number of pleats multiplied by fabric thickness
5	Constant variable	Material selection	Fabric	*Primissima* cotton
	Constant variable		Needle	Sewing needle number 9
	Constant variable		Thread	100% Polyester 20/3 Jeans Hi-Spun Thread
6	Constant variable	Colouring method	Dye type	Remazol Black B (C.I. Reactive Black 5)
	Constant variable		Method	Exhaust dyeing process

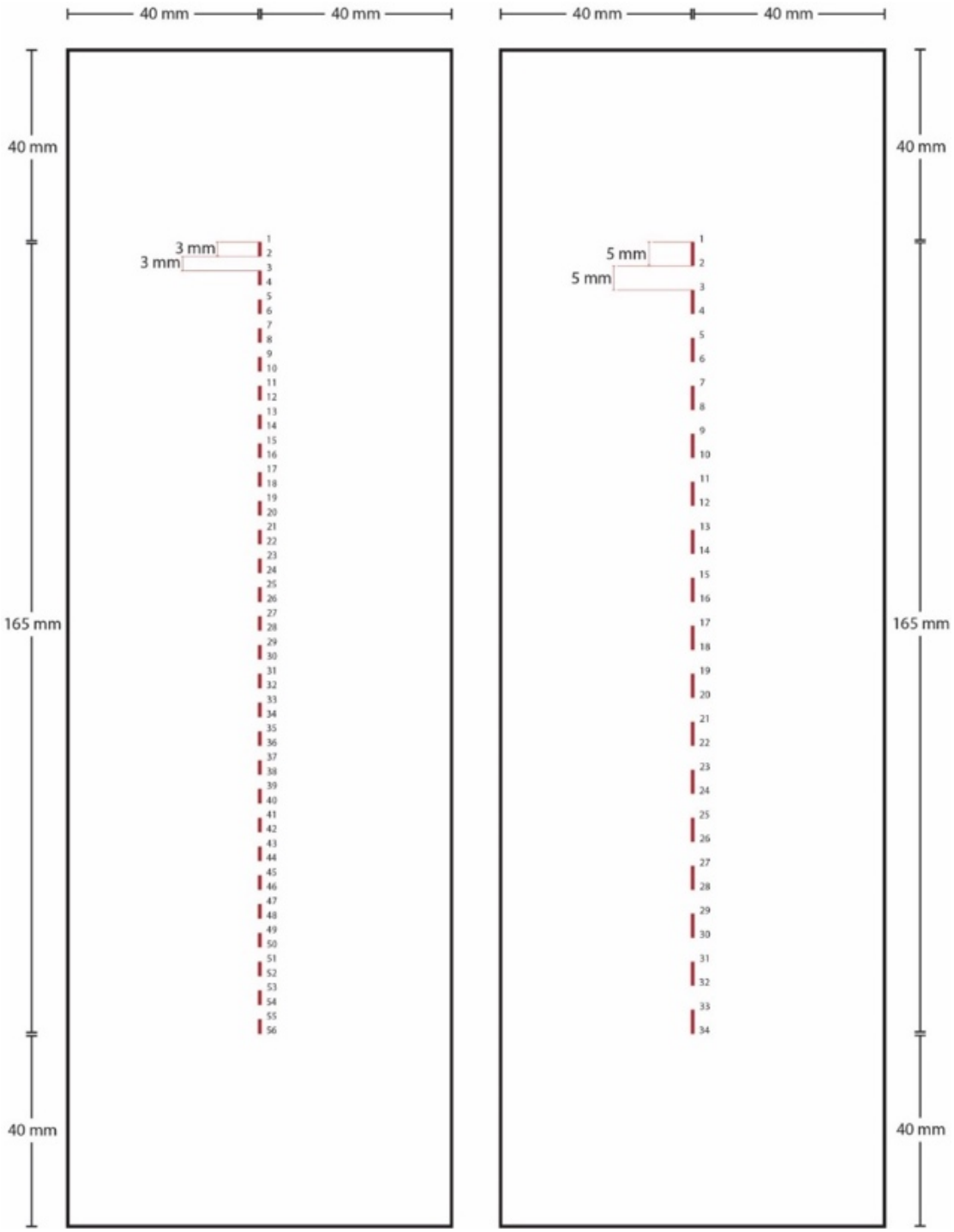


Figure 3.10 Experiment layout on cotton *Primissima* fabric.

Description: (a) 3 mm stitch length and (b) 5 mm stitch length.

The dyeing process was conducted in three batches and the process took three weeks. Each treatment was replicated in three samples which produced 54 samples of Indonesian stitch-resist dyeing cloths. After all the samples were unknotted, dried and ironed, the fabric was conditioned in the

standard atmosphere (temperature of 20,0 °C and a relative humidity of 65,0 %) for 24 hours prior to the measurement (BSi, 2005). The next step was to take a documentation of each sample with the DigiEye camera box. This special camera is specialising in taking a pristine image with equal lighting. The images taken with DigiEye were cropped and saved as TIFF image type so they were ready to be measured with the MATLAB programme. Details of this procedure is explained in section 5.4.1. Once the images have been taken, the samples were set on a neutral grey thick board and numbered for the visual perception analysis stage.

3.5.4 Data analysis phase 2: Objective measurement and visual perception

In this phase, the resultant patterns were analysed based on the pattern clarity and pattern preferences. The analysis process was conducted by two methods: objective measurement and visual perception. The pattern clarity was first analysed with the MATLAB Programme by producing a code that generated three main components: lightness value, number of pixels, and standard deviation from each image. The objective measurement with MATLAB programme was conducted to quantify the resultant stitch-resist dyed pattern and classify pixels as belonging to either pattern or background. The results from this measurement then were compared with values of the three independent variables.

The second analysis process for this phase was a visual perception study. The second analysis aimed to evaluate the visual perception of pattern clarity and preferences by asking participants. The participants involved for this study were 20 individuals who have design background or have a cultural relation with the stitch-resist dyeing technique (Appendix E1). Most of the participants were recruited through the School of Design and the Indonesian community database. The potential participants were approached by sending them an email with an information sheet attached explaining the research aim, the details of the study location, selection of times, research procedures, voluntary action and data protection scheme. Once the participant agreed to take part, the next step was to set a schedule for conducting the experiment at The Colour Laboratory, School of Design. The participants were required to fill in the consent form and given time to

ask any questions before the experiment started. This experiment had two parts, as follows:

1. Part 1: Pattern clarity study
   Participants were asked to examine the pattern clarity of each sample under the light box with D65 (artificial daylight). At the end of part 1, the researcher asked some questions on how the participant defined the pattern clarity. In part 1, a five point of Likert scale instrument was employed to gather the pattern clarity. This part produced an ordinal data which can describe the pattern clarity of each sample based on the participants' answers.

2. Part 2: Pattern preference study
   Participants were asked to rank a group of fabric samples based on their preference. Then, the researcher interviewed the participant about the reason behind their selection. Part 2 used ranking (1-6) to measure the pattern preference based on group. There were six groups consisting of six samples assessed by participants (see Table D1, Appendix D5). The samples on each group were represented the variables: (variable 1) 1% omf colour shade, 2% omf colour shade, 3% omf colour shade; (variable 2) low tightness level, medium tightness level, high tightness level; (variable 3) 3 mm stitch lengths, 5 mm stitch lengths.

At the end, both results from the objective measurement and visual perception were compared and analysed. The results showed the correlation between each variable with the resultant pattern in terms of pattern clarity and preferences. Variable with highest effect to the resultant pattern was prioritised when defining the best framework for Indonesian stitch-resist dyeing practices.

3.6 Summary

The overall methodology has been outlined in this chapter to explain the rationale of the selected research methodology for this study. To attain the research aims and objectives, this study conducted a mixed-method research methodology, combining qualitative and quantitative research. This study also employed a bricolage approach by combining the multiple-case

studies, ethnography, *chaine operatoire*, soft system methodology and laboratory experiment to gather a comprehensive understanding of the Indonesian stitch-resist dyeing practices. Seventy-seven craft makers participated in the survey, and twenty participants took part in the visual perception study. The framework of this study showed an attempt to reach the triangulation exercise in validating the findings. The findings from the survey are presented in the following chapter.

Chapter 4
The Indonesian stitch-resist dyeing practices as case studies

This chapter aims to answer the first two research questions about how commercialisation of the stitch-resist dyed cloths has impacted the Indonesian craft makers. Furthermore, it also provides an explanation to understand the culture, the technical aspects, and the organisational structure related to the stitch-resist dyeing practices in Indonesia. The chapter is constructed based on the survey findings in three locations as the primary data plus related publications as secondary data. The selected case studies for this research are Banjarmasin, South Kalimantan; Palembang, South Sumatra; and Yogyakarta, Central Java.

The stitch-resist dyeing technique has been practiced in many locations in Indonesia, such as Palembang, Banjarmasin, Bali, Sulawesi and Yogyakarta (Hitchcock, 1991; Gillow, 1995; Majlis, 2007; Seman, 2008). Each location produces different aesthetic results that represent the culture and values shared by the local people. Individual stitch-resist dyeing practices have existed in Indonesia for centuries as part of the culture, but the craft industry developed differently in terms of time periods and motives in various locations. Stitch-resist dyed textiles are called *Jumputan* or *tritik* cloth in Yogyakarta, *Pelangi* cloth in Palembang and *Sasirangan* cloth in Banjarmasin (Hitchcock, 1991; Seman, 2008). Examples of traditional designs are presented in Figure 4.1.

Each location has a local term for this technique, particular to the ethnic group that practised it. The stitch-resist dyeing method is well-known internationally under the term *tritik*, which can also be written *teritik* (Hitchcock, 1991). The word is taken from the Javanese language, meaning ‘to drip continually in small drops’ (Hitchcock, 1991, p.97). It is etymologically linked with the term *batik*, meaning ‘to drip’ or ‘to drop’ (Hitchcock, 1991, p.86). Many people in the Java area referred to *tritik* as the name of a traditional cloth rather than as a technique. This is despite the fact that the word *tritik* precisely captures only one type of resist method: the application of stitches to create many small dots (Hitchcock, 1991). Creating small dots can also be achieved by combining *tritik* technique with tying a small part of

a cloth with ropes, which the technique is more popularly known as *jumputan* or *pelangi* among the Indonesian people (Ikle, 1941; Maile, 1969; Gillow, 1995). *Jumputan* means to pick a small amount of fabric (Gillow, 1995). Palembang people refer to this method as *pelangi*, which more accurately refers to the name of their traditional cloth, *pelangi* cloth. The cloth employs a combination of stitch-resist dyeing and tie-dyeing, which why some people also refer to the cloth as a *jumputan* cloth. On the other hand, Banjar people from the South Kalimantan province acknowledge this technique as *sirang* or *sasirangan*. *Sirang* means an activity of creating pleats or creases by gradually gathering a fabric after applying a running stitch; while *sasirangan* refers to any textile product that is created by this technique (Seman, 2008).

(a) (b) (c)

Figure 4.1 Indonesian traditional cloths using stitch-resist dyeing technique: (a) *Jumputan* cloth; (b) *Pelangi* cloth; (c) *Sasirangan* cloth (photos were taken during the survey 2017).

It is apparent that different terms are existed in Indonesia for the same procedure. The Indonesian craft makers tend to think that the terms used by a different ethnic group refer to a different technique because they only recognise their local term. The close related definition between those terms, especially between *tritik, jumputan* and *pelangi* in Yogyakarta and Palembang, are considered to lead into misunderstanding. Therefore, this

study uses the term stitch-resist dyeing as a more neutral definition that has no relation to any particular culture. The stitch-resist dyeing term in this study covers any technique that utilises a running stitch to create a resist area, either hand stitched or machine stitched.

4.1 Case study 1: *Pelangi* cloth from Palembang, South Sumatra

Pelangi cloth (Figure 4.1b), or sometimes written as *plangi*, is one of the traditional cloths from South Sumatra and more specifically from Palembang, the capital city. Beside *pelangi* cloth, Palembang also has another exquisite textile which is popularly called *songket* cloth, a handloom woven cloth with supplementary weft metal threads (Maxwell, 2003). *Pelangi* means rainbow in Indonesia, and the cloth of this name is also well-known for the colourful patterns representing the rainbow colours (Hitchcock, 1991). The traditional pattern of *Pelangi* cloth has a composition of plentiful small circles framed with stitch-resist dyed lines. The small circles are created using a tie-dyed technique, which is locally called *jumputan*, thus some local people also refer to this cloth as *jumputan* cloth. The cloth usually has a red background and multicolour dots inside small white circles. The colourful *pelangi* cloths were noticeable the most outstanding resist dyeing cloths produced in Indonesia (Gillow, 1995; Hann, 2005). The practice of making Indonesian cloths has been strongly influenced by other countries, especially from India (Tirta and Sarabhai, 1988). The diffusion and adoption processes between Indian and Indonesian cultures presumably happened during trading since the seventh century (Tirta and Sarabhai, 1988; Maxwell, 2003), although it is difficult to point out significant proof since a diffusion process would invariably not appear identical in both countries (Hann, 2013). The compositional layout of *pelangi* cloth is strongly related with the *patola* cloth, double-*ikat* cloths of Gujarat (Hann and Thomson, 1993, p. 16), and the technique is very similar with the *bandhani*, a tie-dyed cloth also from the Gujarat area (Tirta and Sarabhai, 1988).

Based on a survey findings and references from Juliana (2010), some authentic features of *Plangi* cloth pattern compositions are identified. They are *bintik lima* (five dots), *bintik tujuh* (seven dots), *bintik sembilan* (nine dots), *kembang jamur, bintik-bintik* (many dots), *umpak, patah beras* and *sumping/terong*. Five from these motifs are considered as the main motif

(Figure 4.2). The *bintik lima* motif consists of five small circles that are arranged in a diamond shape (Figure 4.2a), while the *bintik tujuh* consists of seven small circles framed inside a simple flower shape (Figure 4.2b). The *bintik sembilan* also has similar arrangement as the *bintik tujuh* pattern, but it consists of nine small circles instead of seven small circles (Figure 4.2c). All the small circles are created with the tie-dyeing technique, or *jumputan*, while the large diamond and flower pattern are produced by the stitch-resist dyeing technique. The *sumping* motif, meaning ear jewellery, is a shape that looks very similar to the paisley pattern (Figure 4.2e). Some people call it a *terong* motif, referring to the shape of an aubergine. The *kembang jamur* motif, which translates as a mushroom flower, is presumably inspired by a flower shape (Figure 4.2d). The other motifs are considered as supplementary motifs, including *umpak* which means zigzag lines, usually arranges as a border; *bintik-bintik* which means plenty of dots, usually uses as a mean to fill the gaps between the main motifs; and *patah beras* which is formed as horizontal lines.

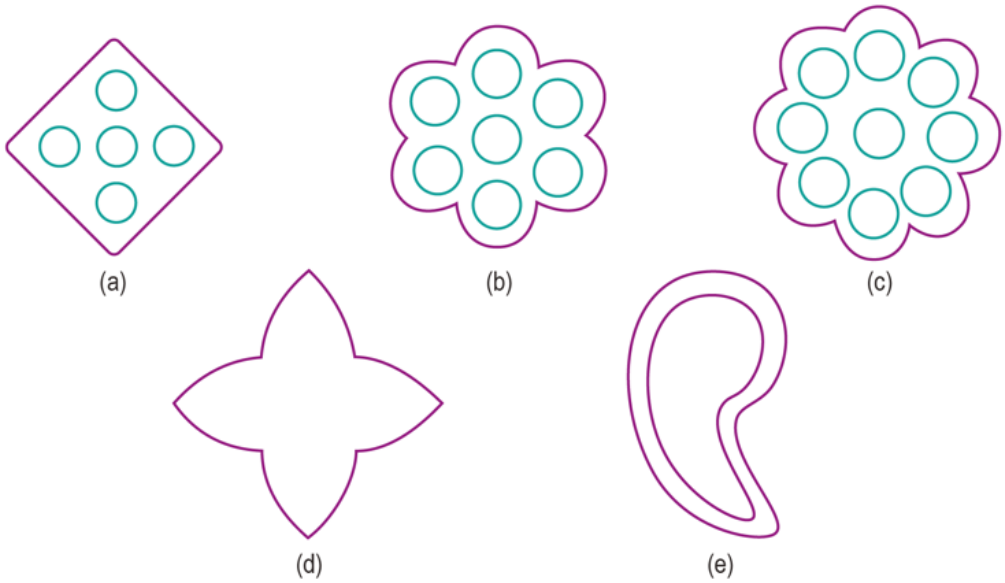


Figure 4.2 Illustration of traditional individual motifs in *Pelangi* cloth.

Description: (a) bintik lima, (b) bintik tujuh, (c) bintik sembilan, (d) kembang jamur, (e) sumping/cucung/terong

All of the motifs are traditionally composed in certain ways. *Pelangi* cloths were principally used as women's shawls, sashes, girdles, breast wraps, handkerchiefs, and as an essential part of dancer's accessory (Buhler, 1954:

p. 3740); nowadays the craft makers produce them mostly for sarongs and shawls. The size of a sarong is commonly 200 centimetres length and 100 centimetres width, while the size of shawls is 200 centimetres length and 80 centimetres width. Sarong and shawls have a distinctive authentic pattern layout with three partitions, which are the *kembang tengah* or *bungo tengah* part, the *tumpal* part, and the *kembang pinggir* part (Juliana, 2010). The layout of shawl and sarong is presented in Figure 4.3 (Juliana, 2010).

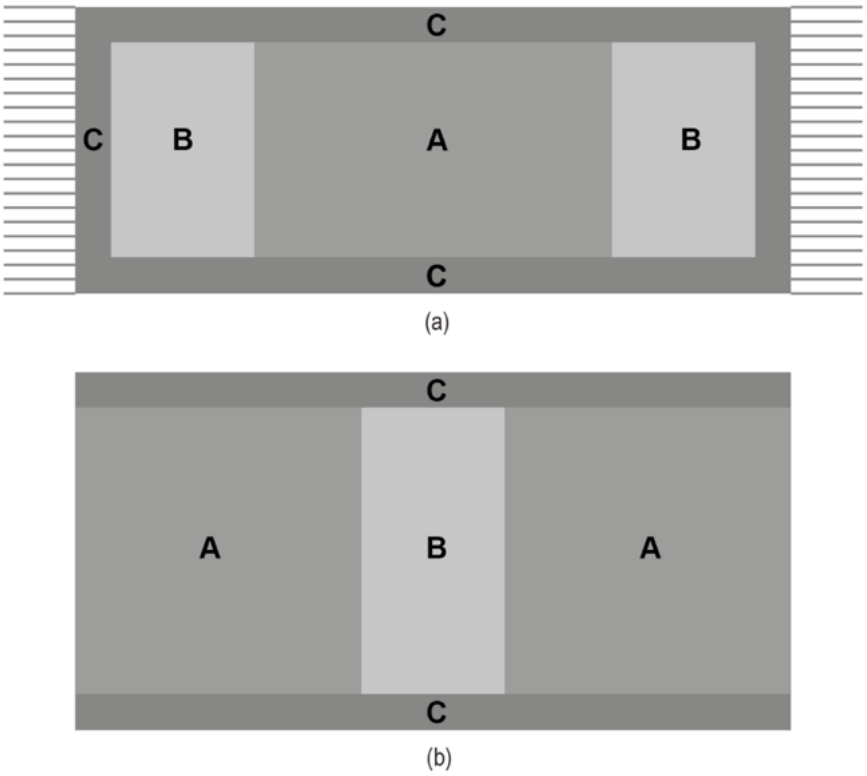


Figure 4.3 Traditional layout of *Pelangi* cloth as (a) shawl and (b) sarong.

The layout for either shawl and sarong consists of three parts:
A. *kembang tengah* or *bungo tengah* part.
B. *tumpal* part.
C. *kembang pinggir* part.

The *kembang tengah* pattern is functioned as the main pattern that is usually combined with main motifs in Figure 4.2, except *sumping* or *terong* motif, plus the supplementary motifs. Each motif is generally arranged in a full repetition to fill the area in the centre. The *kembang tengah* is placed in the

middle for shawls and on the side for sarong; it usually switches position with *tumpal*. The term *tumpal* could be defined as a part of a cloth that has some specific motifs, usually locates at the edge of the cloth which later become an upfront part if the cloth is worn as a sarong. In the traditional *pelangi* cloth, the *tumpal* part is always composed with the *sumping* or *terong* motifs. They are commonly arranged in a repetition of five to seven motifs and then framed with zigzag lines. Plenty of small circles or *bintik bintik* would spread between *sumping* motifs, filling up the *tumpal* area in a particular arrangement that is usually called *tawur*. A layout of traditional composition and a contribution of technique on a *pelangi* scarf is illustrated in Figure 4.4. Two resist dyeing techniques, stitch-resist dyeing and tie-dyeing, are combined in the process of making *pelangi* cloth. The percentage between the application of stitch-resist dyeing and tie dyeing techniques in *pelangi* cloth is almost equal; the pattern does not form if either of the techniques is not used.

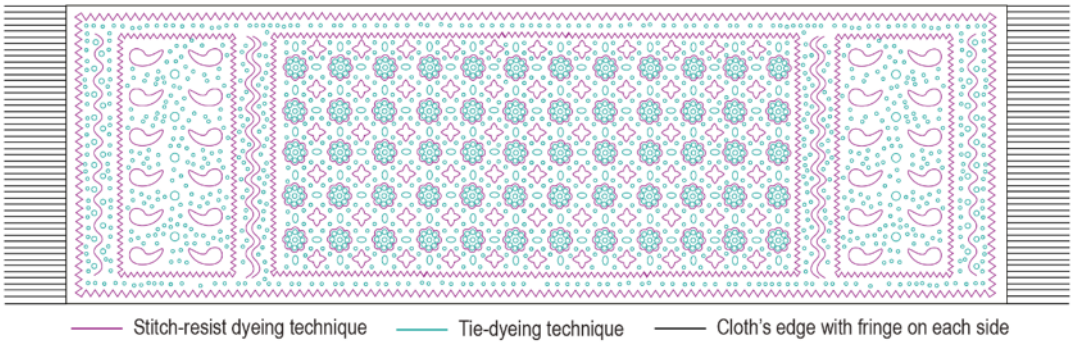


Figure 4.4 An illustration of traditional *pelangi* design layout as a scarf with *bintik sembilan* pattern.

In more recent times, many craft makers in Palembang have started to produce contemporary *pelangi* cloths which employ non-traditional pattern composition, and even some of them are being coloured in a monochromatic combination. The main reason for these changes is purely because of market and economic drivers. The new design is sparser, giving more space in between motifs, which necessitates a smaller number of motifs in one cloth. The new design is composed with half the fabric consisting of no pattern, usually the no pattern area is located in the middle of the cloth (see Figure 4.5). The new design compositions reduce the amount of time

necessary for making one piece of cloth, which implies the craft makers can produce a higher quantity in one given period of time. The monochromatic colour combination is created as an alternative design to reach a wider segment of consumers and a more modern look. Despite all the changes, the term would remain the same for the latest *pelangi* cloth, as long as it is produced with a similar method and showcases small needle holes resulting from the stitch-resist dyeing technique. It implies that the production method is the most important and valuable meaning of *pelangi* cloth.

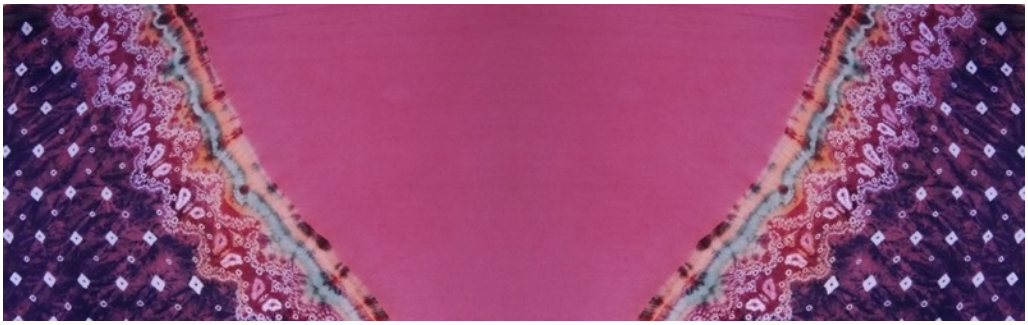


Figure 4.5 The innovation in design of *pelangi* cloth by the craft makers from Palembang (photo was taken during the survey 2017).

4.2 Case study 2: *Sasirangan* cloth from Banjarmasin, South Kalimantan

Sasirangan cloth is a traditional cloth from the South Kalimantan province, which mainly flourishes in the capital city, Banjarmasin, but then spread out to the outskirt area of Banjarbaru city. The cloth is adopted from a traditional cloth from the same province, called *pamintan* cloth. *Pamintan*, translates as an invocation, symbolising an action of asking for help to a shaman for curing particular diseases (i.e. specific person who was believed to have a special power) through a special cloth (Seman, 2008, p. 1-2). The person then creates the *pamintan* cloth with specific patterns that spiritually have an energy to cure the illness (Seman, 2008, p. 1-2). Each pattern has a specific power to heal different kind of pain, for example, *naga balimbur* (dragon with fire) pattern was believed to reduce a fever (Redho, 2016). The pattern is drawn on a yellow stitch-resist dyed cloth with a red diamond shape (*modang*) in the middle and green *bayam raja* pattern as a borderline (Figure 4.6). A small number of this spiritual treatment using a *pamintan* cloth, called

batatamba, still exist in Banjarmasin, although the supernatural process remains secret.

Figure 4.6 Examples of the *pamintan* cloths (photos were taken during the survey 2017).

The custom of making *pamintan* cloth has been existed since 16th century (Seman, 2008), but the design transformation into the *sasirangan* cloth was happened around 1980. The initial idea was to establish new authentic and marketable goods from Banjarmasin inspired by the pattern and technique of *pamintan* cloth. The notion was aimed for women empowerment in that area, which is later discussed in section 4.5.1. The craft makers in Banjarmasin refer to the stitch-resist dyeing technique with the term *sirang* which is the local word meaning wrinkle. The *sasirangan* signifies a verb which describes the activity of creating the wrinkle with a running stitch. The term wrinkle refers to the creases which result after the stitched thread has been pulled.

Seman (2008) stated that the authentic feature of *Sasirangan* cloth is a colourful cloth with a vertical composition of two or three long lines combined with figurative shapes. The vertical composition means the pattern follows the length direction. The traditional figurative shapes represented natural objects from the surroundings. The typical composition and a contribution technique of *sasirangan* cloth is illustrated in Figure 4.7. The stitch-resist

dyeing technique is used as the main technique to create the pattern on *sasirangan* cloth. This layout distinguishes *sasirangan* cloth from *pelangi* cloth or *batik* cloth that tend to have a horizontal composition. *Pelangi* cloth or *batik* cloth are initiated for *sarong* or shawls, while *sasirangan* cloth is initially intended for garments, which require a fabric with size of 2 – 3 metres length with 1 – 1.5 metres width. The size is suitable for making a woman's blouse, woman's robe, and men's shirt.

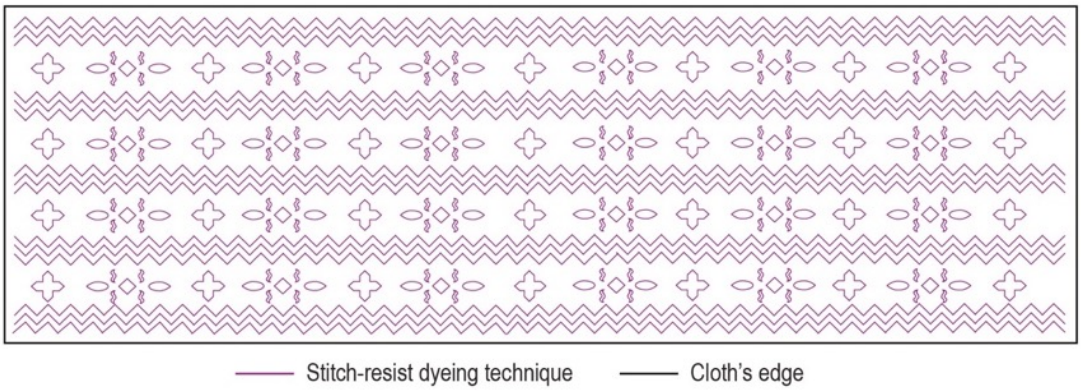


Figure 4.7 An illustration of typical pattern layout of the *sasirangan* cloth for garment.

After establishing for almost forty years, *sasirangan* cloth has become the most well-known traditional cloth in Banjarmasin. The local government and communities have fully supported its development. More trainings have been supported in the past decades and an official community is formed with name *Komunitas Pencinta Sasirangan* (KPS), means the *sasirangan* lover community. Banjarmasin government also held the annual *Sasirangan* Carnival since 2017 as part of their tourism programme, which has raised an awareness of *sasirangan* cloth. As part of the carnival, the local government also establishes a *sasirangan* design competition to encourage the craft makers become more creative in designing *sasirangan* pattern. Some new outstanding designs are born from this event, one of the examples is the peacock pattern (Figure 4.8b). All stakeholders in Banjarmasin play an important role to support the craft makers and local designers exploring new designs to be more in line with a contemporary lifestyle without eliminating the authenticity of *sasirangan* cloth. Examples of the latest design of *sasirangan* cloths are presented in Figure 4.8.

(a) (b)

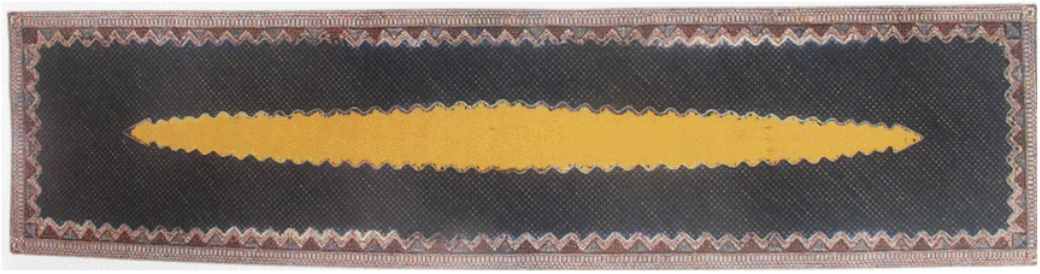
Figure 4.8 Some examples of the latest design of *sasirangan* cloths.

Descriptions: (a) A new composition by Haris *Sasirangan* that consists of more geometrical patterns; (b) The peacock pattern created by Ori *Sasirangan* that won the design competition on 2017 (photos were taken during the survey 2017).

4.3 Case study 3: *Tritik*, *Kembangan* and *Jumputan* cloths from Yogyakarta, Central Java

Javanese textile making in Yogyakarta area employ three terms in relation to the stitch-resist dyeing technique: *tritik*, *kembangan*, and *jumputan*. As it mentioned before, *tritik* is a term in Javanese language for a stitch-resist dyeing technique (Hitchcock, 1991). This technique is strong related with two typical patterns: first, a pattern composition of three dots with white outlines and a colourful accent in the middle (Figure 4.9b), and second, is a pattern with lozenge-shaped centre field design surrounded by a stitch-resist line as a border (Figure 4.9a). A cloth with the first pattern is known as a *tritik* cloth, while a cloth with the second pattern is recognised as *kembangan* cloth. Both cloths have been existed for long period of time, recording to a note in 1850 of a shipment of *kembangan*, or *tritik* patterned fabrics from Java (Buhler, 1954: 3751). Based on Javanese culture that applies to Yogyakarta, *kembangan* cloth is aimed for some ritual ceremonies, such as wedding ceremonies, circumcision ceremonies, housewarming, and birth ceremonies (Gittinger, 1985, p.25). In wedding ceremony, *kembangan* cloth is mostly functioned as *kemben* (breast-cloth) – a part of *dodot* (i.e. a long ceremonial

wedding cloth, but also placed near focal points of ritual concern, the bed-of-state, the rice pot and the orchestra (Gittinger, 1985, p.25; Hitchcock, 1991). A circumcision ceremony requires seven pieces of *kembangan* cloths with a designated pattern for offerings; while other set of eight *kembangan* cloths are utilised at ceremonies of pregnant women (Gittinger, 1985, p.25). The similar set of eight *kembangan* cloths also is required for celebrating a new house (Gittinger, 1985, p.25).



(a)

(b)

Figure 4.9 (a) *Kembangan* cloth (Majlis, 2007), and (b) *tritik* cloth (photo was taken during the survey 2017).

The last term used in Yogyakarta area, *jumputan*, is a Javanese word means to pinch a small part of a fabric and then tie it with a rope to create a small circular pattern (Gillow, 1995). The typical design of *jumputan* cloth is described in Figure 4.1a. Stitch-resist dyeing technique, or *tritik*, is applied as a small part of the process in producing a *Jumputan* cloth. The amount of stitch-resist dyeing technique application on *Jumputan* cloth is described on

the illustration in Figure 4.10. Majority of the pattern are created by applying the *jumputan* technique after sewing the pattern first, this technique would fill the inside of pattern.

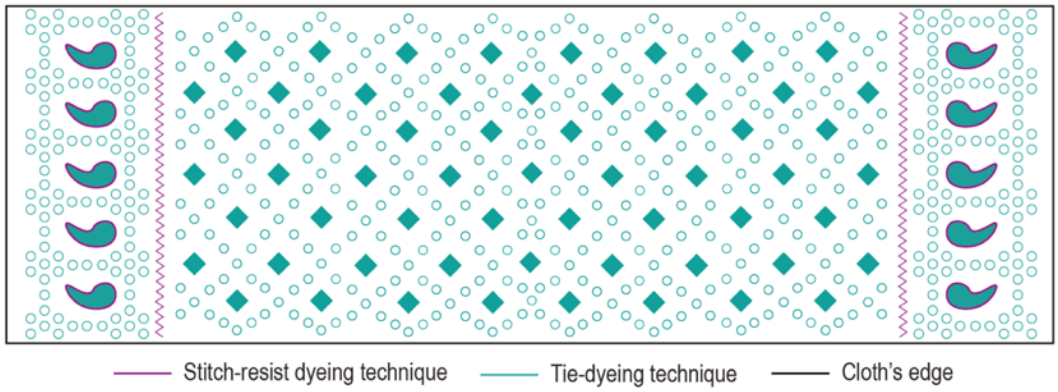


Figure 4.10 An illustration of typical pattern layout of the *jumputan* cloth for a sarong or garment.

Nowadays, the craft makers manufacture only *jumputan* cloth as a product commodity, the other cloths are remained as part of ceremonies or formal occasion. The *jumputan* cloth is produced as a cloth for garment or a traditional sarong for formal occasion with a size of 2 – 3 metres length with 1 – 1.5 metres width. The production of *jumputan* cloths only starts since one decade ago, but the design has been rapid growth with lots of modifications. Having a close relation with *batik* process has given the practice lots of benefit, in terms of knowledge about colouring process (e.g. natural dyeing process), and easier access to different kind of materials and also latest information. Some of the latest design of *jumputan* cloths are presented in Figure 4.11.

(a)

(b)

Figure 4.11 Some examples of the latest design of *jumputan* cloths.

Descriptions: (a) A new design composition inspired by nature made by Tizania *jumputan* in Yogyakarta (Tizania *jumputan* official documentations, 2020), and (b) A *jumputan* cloth with an abstract effect from the VAT dyeing process (photo was taken during the survey 2017).

4.4 *Chaine operatoire* of the Indonesian stitch-resist dyeing practices

The analysis of stitch-resist dyeing sequence in this study employed the *chaine operatoire* method. The application of this method aims to describe detailed information about the use of stitch-resist dyeing in Indonesia. The analysis consists of an examination of tools, materials,

duration, gestures and localities (Lemonnier, 1992). The process of stitch-resist dyeing on an individual scale and an industrial scale are different. The description in chapter two, the literature reviews of stitch-resist dyeing technique, refers mostly to an individual practice of the stitch-resist dyeing technique. The industrial scale employs a similar principle, but an adjustment is made to expand the quantity and to reduce the production time. The adjustment has shifted the practice from an individual work into a community work. The explanation of how the community is functioned described in section 4.5.

A typical stitch-resist dyeing sequence was explained by the Indonesian craft makers during survey in three locations. Those information has been summarised into eleven steps that encompass the entire process of manufacturing the stitch-resist dyed cloths. The first six steps are illustrated in Figure 4.12, and the last five steps are described in Figure 4.13. Those steps are classified into four phases by the researcher to signify the one aim from several steps: designing process, stitch-resist process, colouration process, and finishing process. Each step was analysed by looking at the *chaine operatoire* elements: tools, materials, duration, methods, gestures and localities. In the original application of *chaine operatoire*, the term locality referred to the location where the artefact was found. This study refers the locality as the culture or belief within the society of stitch-resist dyeing makers in each location.

Some sequences in Figure 4.12 and Figure 4.13 indicate various options concerning tools, materials, and methods. These varieties are strongly driven by their localities and also the market demand. For example, the choice of using synthetic raffia creates big holes on the resulting pattern, which the big holes had become the signature trait of authentic *pelangi* cloth from Palembang. Therefore, the craft makers believe that it is essential to keep the tradition by employing specific tools to attain the signature trait.

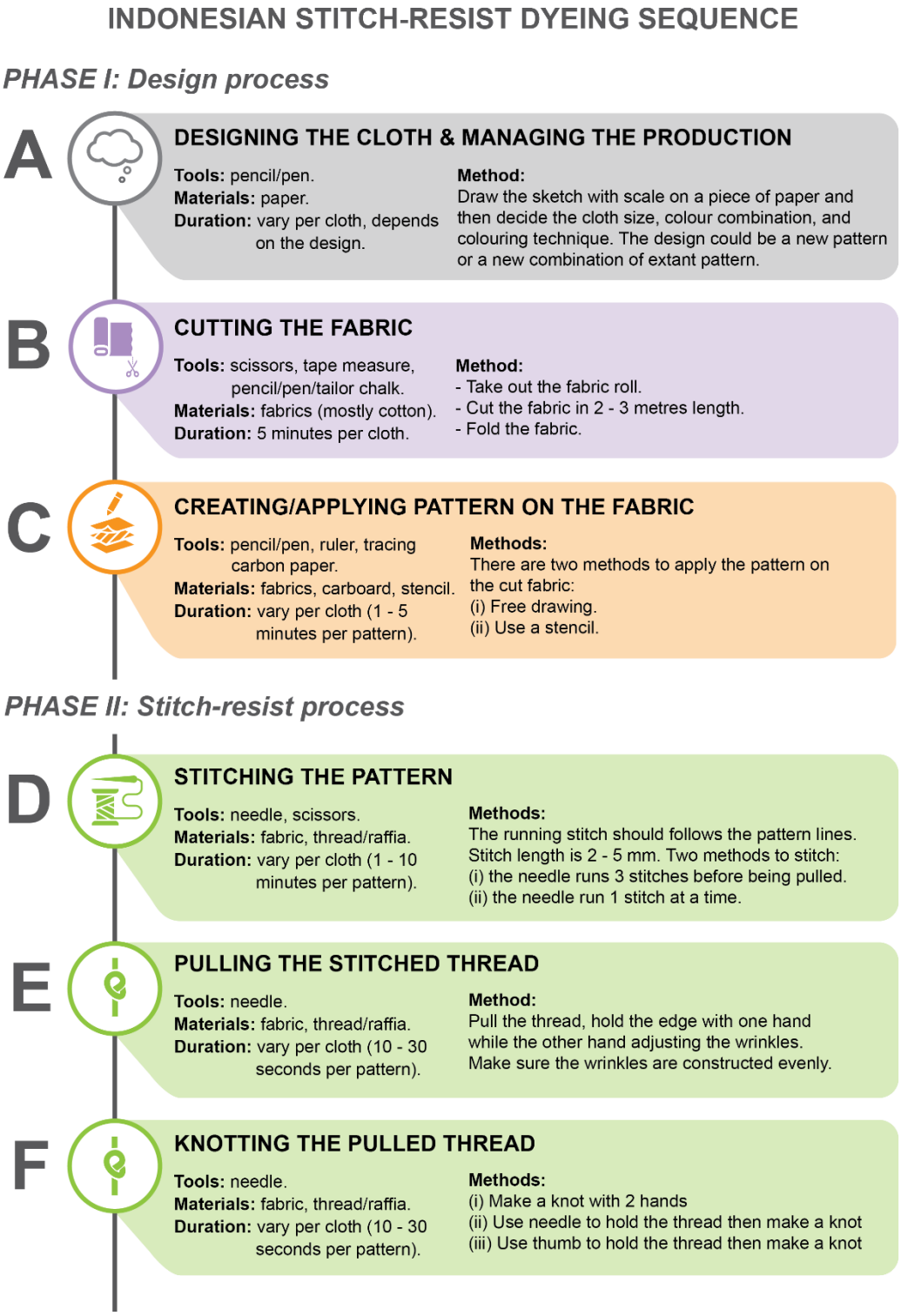


Figure 4.12 *Chaine operatoire* analysis part 1.

Part 1 consists of phase 1 and phase 2 of typical stitch-resist dyeing practice among Indonesian craft makers.

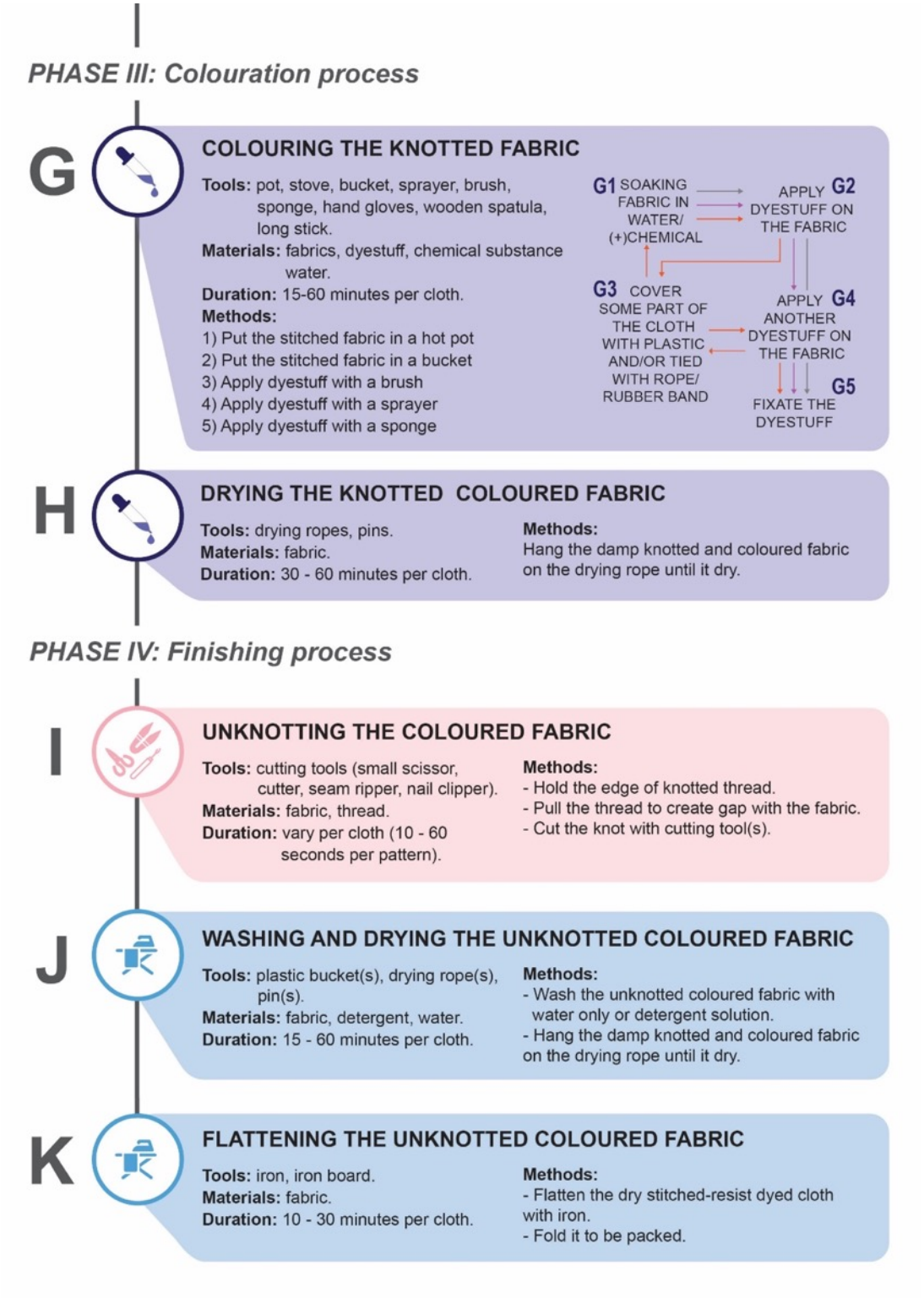


Figure 4.13 *Chaine operatoire* analysis part 2.

Part 2 consists of phase 3 and phase 4 of typical stitch-resist dyeing practice among Indonesian craft maker

Some variations of sequences are discovered between each location. The comparison between each location is illustrated in Figure 4.14. The grey arrow shows the typical sequence in that area which means that the majority of craft makers employ that sequence. The green arrow provides the atypical sequence in that area that is conducted by a small number of craft makers. For example, a typical stitch-resist sequence (step D – E – F) that is employed in Palembang and Yogyakarta is also conducted by a few craft makers in Banjarmasin. Thus, that sequence is considered uncommon in Banjarmasin and it is illustrated with green arrows in Figure 4.14. Another example is shown in the colouring sequence; the sequence of G1 - G2 - G4 - G5 exists in all areas. However, this sequence is rarely employed in Palembang and Yogyakarta compare to Banjarmasin. Therefore, that sequence is also illustrated with green arrows in Figure 4.14. The figure shows significant variations in phase two, the stitch-resist process (step D – E – F) and phase three, the colouring process (step G). A further discussion of each variation is presented in section 4.4.2 for the stitch-resist process and 4.4.3 for the colouring process.

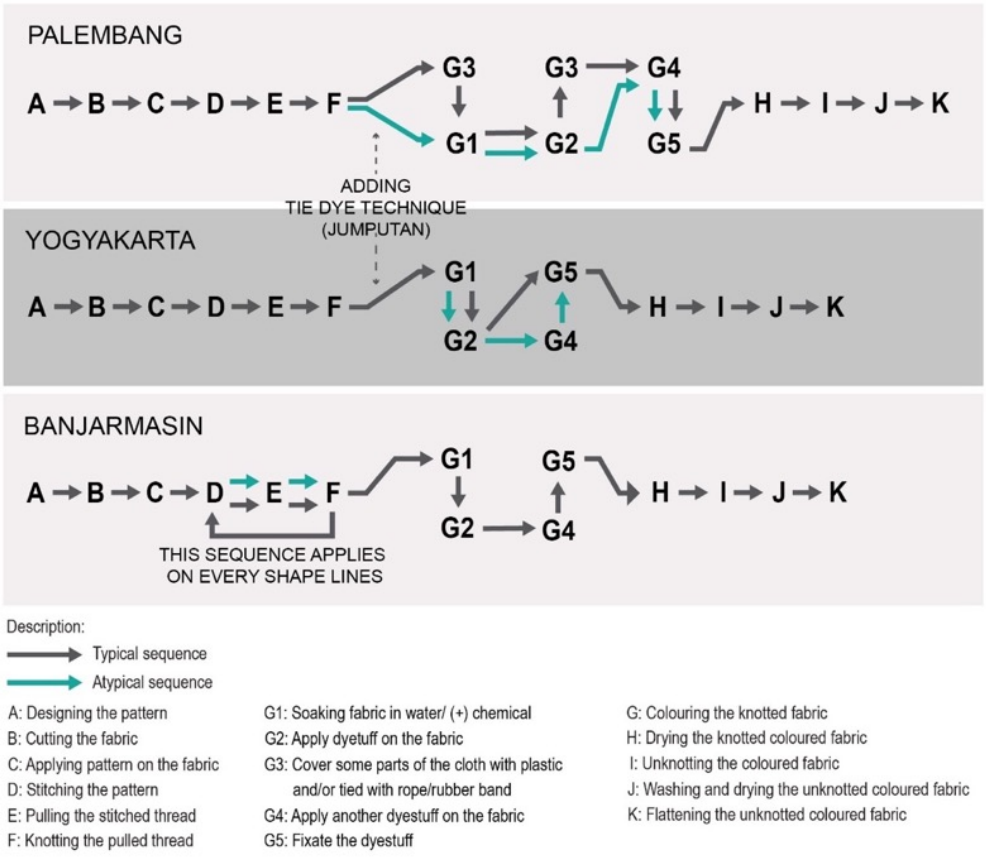


Figure 4.14 *Chaine operatoire* analysis: comparison of stitch-resist dyeing sequences between three locations in Indonesia (Titisari, 2018).

4.4.1 Phase 1: Design process in the Indonesian stitch-resist dyeing practices

The main objective of these craft practices is to produce the stitch-resist dyed cloths as a commodity product. The targeted market has changed from regional into national, and some of the craft makers have reached the international market. Along the way, the market has also created a customised product. As explained in chapter one, this expansion is strongly affected by the Indonesian government regulation that encourages every corporate employee to wear clothes made by traditional cloth at least once a week. Therefore, most of the stitch-resist dyeing practices in the three locations have two channels of production scheme: retail and customised products. Each channel has different approaches, especially in the first step, designing the pattern. For retail products, the design is created based on the designer's creativity to fulfil the market demand; it usually comes with more exclusive unique designs. Meanwhile for customised products, the design comply with the customer request. Most of the customised order come in significant quantities within one design. Thus, the design is less personal because it shows more the group identity than an individual characteristic. A comprehensive discussion about the traits of retail and customised products is provided in section 6.1.2. The following discussion in this section explains the process of creating a design on both retail and customised Indonesian stitch-resist dyeing products.

The cloth design is a primary key because it defines the production scheme. Several considerations are involved while designing the cloth, such as the function, the cloth size, material selection, pattern composition, and colour combination. These five aspects influence each other and become the deciding factors whether the design is successful or not. The first aspect to decide is the function because it will determine the other aspects, especially cloth size and material selection. Overall, the common use of stitch-resist dyed cloth is for fashion products. It can be worn loosely as a scarf or a sarong; or can be tailored as clothes (i.e. shirt, blouse, gown, robe). The typical size for the scarf is 1 – 2 metres length with 60 – 1.5 metres width and usually it has fringe on each side. Indonesian people wear a scarf for formal occasion, thus a scarf is generally created with loose and shiny materials, such as silk, viscose, and rayon. Sarong and fabric for clothes have similar size; it is 2 – 3 metres length with 1 – 1.5 metres width. The difference between them is usually the material selection. Sarong is preferably produced with a loose material so it can be easily formed a

drapery; while fabric for clothes could use more options depending on the type of clothes.

Generally, Indonesian people divide their material purposes into two general categories: cotton or rayon for casual clothes, and silk or viscose for formal clothes. Although the rule is not strict, and it can be applied for both female and male. Corporate wear for both men and women usually require a similar length, 2 metres for a short sleeve shirt or blouse and 3 metres for a long sleeve one. For the retail products, decisions on fabric selection by the Indonesian craft makers are based on the design, colouring skill, customer demand and material availability. Three types of fabric are utilised in the stitch-resist dyeing practice, which are cotton, silk, and viscose/rayon. The number of fabric types use by the stitch-resist dyeing craft makers are not the same in each location (Figure 4.15). The percentage on each fabric category is referred to the total number of enterprise or cooperative group in each location who participated in the survey.

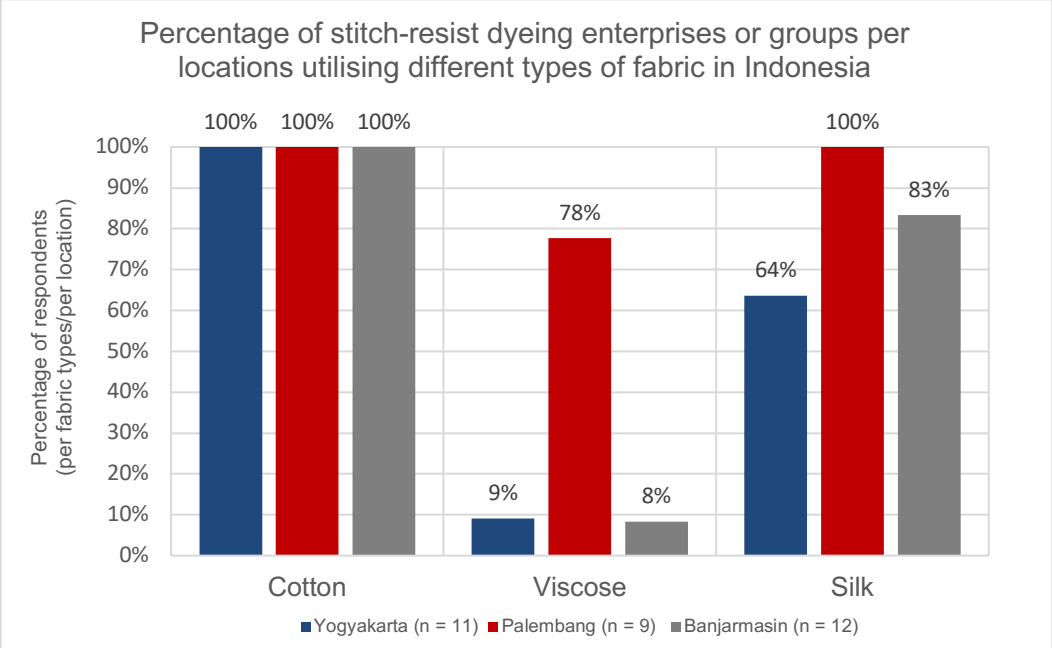


Figure 4.15 Percentage of stitch-resist dyeing enterprises or groups per locations utilising different types of fabric in Indonesia.

All craft makers in three locations utilise woven cotton. The hydrophilic character makes cotton very absorbent (Choudhury, 2006); therefore, it is

suitable for moisture control in Indonesian weather. It also implies that cotton is a good absorbent to dyestuff. The physical structure of cotton fibre also forms a durable fibre; thus, cotton is famous for its inherent durability for washes. The cotton fabrics are constructed in different types, but the most popular one in Indonesia is cotton *primissima*. Cotton *primissima* is the best quality cotton fabric manufactured by local Indonesian mill, mostly in the Java area. Cotton *primissima* is typically constructed as follow: (i) yarn/thread number for both warp and weft are Ne (50/1) or (60/1); and (ii) the fabric density is 105-125 ends per inch (epi) for the warp and 100-120 picks per inch (ppi) for the weft. This cotton employs British thread number system (Ne), which is the indirect system to count thread in terms of length (840 yards) per unit weight (1 lb). The higher the yarn number, the finest the thread. The number next to the yarn number refers to the number of strands (ply). Fabric density indicates the number of warp yarns and weft yarns in a one-inch square. Higher fabric density indicates a denser fabric. That construction implies that the cotton *primissima* has a delicate structure which made it a very light and dense fabric. This type of fabric is suitable for the Indonesian tropical weather.

The use of viscose fibre is widespread in Palembang, in comparison to other locations. Seventy-eight per cent of total respondents in Palembang utilise viscose fabric as their product designate; while less than ten per cent of total respondents are utilised this fabric type in other locations (Figure 4.15). Viscose fabric is generally soft, comfortable in hot and humid conditions, drapes well, highly absorbent and easy to dye (Clark, 2011). Therefore, viscose fibres give comfort but suffer from a much lower breaking strength, particularly when wet. Most viscose fabrics in Palembang are constructed with geometric Dobby woven pattern. Dobby woven pattern is a type of pattern produced by a Dobby loom, characterised by a small geometric pattern with textures. This Dobby woven fabric is blended splendidly with the *pelangi* pattern that mostly has a geometrical pattern too (Figure 4.19a).

The last fibre use by the Indonesian craft makers in the diagram is silk (Figure 4.15). The diagram shows an average usage of silk in all three locations is higher than viscose. More than half of participants in each location utilise silk fabric in their practice. Silk fibres are very fine with a soft and high lustre characteristic (Clark, 2011), which appeals to lots of Indonesian people to look more sophisticated in a formal occasion.

Although, the use of silk fabric in three locations is presumably not pure silk fabric; it could be a mixed fibre or a silk imitating synthetic fibre.

After every aspect of design had been decided, the process continues by cutting the fabric by a predetermined length. Some craft makers built a specific instrument on the wall to measure the fabric more comfortably and quicker in a significant quantity. The instrument consists of several nails, attached in distances of 50 cm and 100 cm. Thus, the craft makers can attach multiple plies of 50 cm length of fabric to the nail, then for example, cut the fabric in three plies to get a piece of fabric with 150 cm length (Figure 4.16a). This method is considered very helpful because it does not require lots of space, and it is relatively straightforward using fabric gravity.

(a) (b)

Figure 4.16 Typical of Indonesian stitch-resist dyeing makers on conducting the phase 1 (photos were taken during the survey 2017).

Description: (a) Cutting the fabric and (b) applying the pattern on fabric

The next step in this phase is applying the pattern on the cut fabric. This step is intended to transfer the design sketch into an actual ratio (1:1) on the fabric. The design can be a newly developed pattern or a different

composition of the existing pattern. For repeating the pattern within one fabric or into another fabric, most of the craft makers create a template with a thick board. The craft makers put the template on the fabric surface and then draw lines following the template with a pencil or pen (Figure 4.16b). Many craft makers fold the fabric and insert the carbon paper in between to produce a repetitive pattern faster. The method is related to the explanation on the section transferring the design (see section 2.3). Figure 4.16b also captures the Indonesian culture who rather to sit on the floor than to sit on the chair while working. None of the craft makers refer that situational as uncomfortable, they seem to be more convenient on that informal and more approachable setting to other craft makers.

4.4.2 Phase 2: Stitch-resist process among the Indonesian stitch-resist dyeing craft makers

Phase two consists of the resisting part in stitch-resist dyeing technique. It has three steps: (i) stitching the thread on the fabric; (ii) pulling the thread; and (iii) knotting the thread at the end (Larsen et al., 1976; Seiler-Baldinger, 1994). Three findings are summarised in this section from examining this phase in three locations. First, an explanation of how this phase is conducted in Indonesia with a signature gesture in making the first knot (step D in Figure 4.12). Second, a different sequence applies in two locations within this phase (see Figure 4.14). Third, a discussion of different selection of materials for sewing thread is practised in some areas.

The first finding, the stitch-resist phase is done manually by the Indonesian craft makers. The craft makers in three location only employ running stitch type. Some craft makers in Banjarmasin and Yogyakarta create an authentic method in performing step D (stitching the pattern), so they could create a quick and more consistent size of knot to start with (Figure 4.17 a1 – a4). The beginning position always started from above the fabric not from under (Figure 4.17b); thus, it would make the stitch length and distance estimation easier. The regularity of stitch length and distance were stated between 2 – 5 mm (Figure 4.17c). The basic knot step (see Figure 2.10) was applied by majority of the craft makers to tighten up the sewing thread. The craft makers only depend on their eyesight and the sewing needle to perform a consistent stitch length and a firm knot tightness, which it requires a high craftmanship to give the best performance.

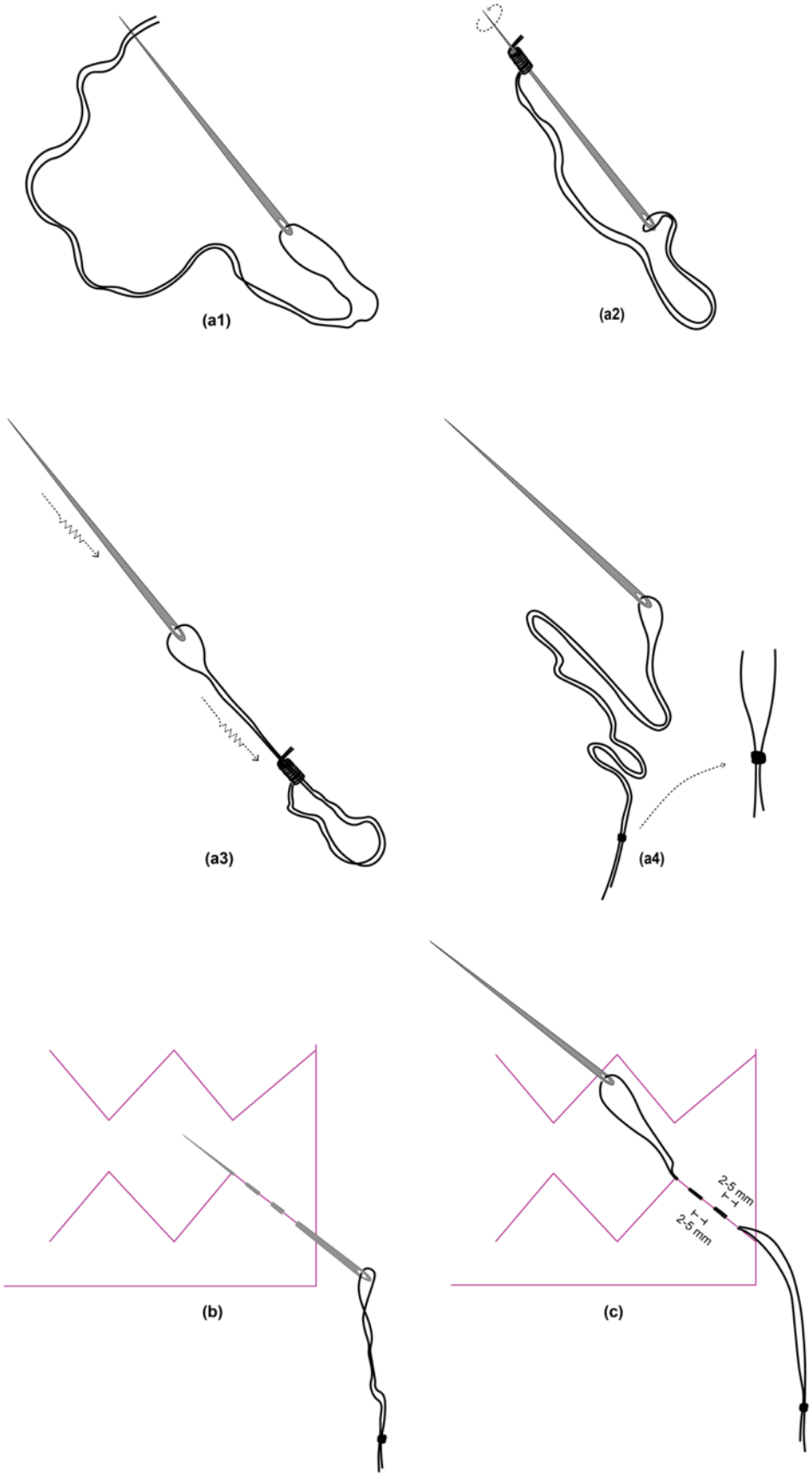


Figure 4.17 Sequence in conducting the step D (stitching) with an authentic method in making a knot on the sewing thread by the craft makers in Banjarmasin and Yogyakarta.

Description:
(a1) Insert the sewing thread into the needle's hole and then place the end part of the sewing thread on the needle's tip.
(a2) Wrap the sewing thread 3 – 4 times tightly around the needle.
(a3) Pull the bundle of sewing thread down to the bottom tightly.
(a4) A consistent knot is formed at the end of the sewing thread.
(b) Insert the needle into the fabric from the top side and follow the pattern. Try to create a distance around 2 – 5 mm between the needle's punctures.
(c) Pull the needle out.

The second finding, the craft makers in Yogyakarta and Palembang employ the same sequences in this phase, while the craft makers in Banjarmasin conduct this phase differently (Figure 4.14). There are various aspects that cause the difference in conducting this stitch-resist phase in those three locations. The craft makers in Yogyakarta and Palembang conducted step E (pulling the stitched thread) and followed by step F (knotting the pulled thread) after the entire patterns in the fabric had been sewn (step D). They also added the tie technique (or *jumputan*) at the same time conducting step E and F of the stitch-resist process.

Figure 4.18 A portrait of working collaboratively between the stitcher and the knotter in Palembang.

Description: A collaboration between stitcher (middle) and knotter (left) in conducting the stitch-resist process (photo was taken during the survey 2017).

This particular sequence was conducted in Palembang and Yogyakarta because the craft makers want to create specific resultant patterns (see Figure 4.4 and Figure 4.10). In result, the sequence also creates different working situation in those two locations. The sequence provided an opportunity to conduct the stitch-resist phase by two craft makers (Figure 4.18). The first craft maker sews the entire pattern on the cloth (step D). Once all pattern had been sewn, the first craft maker then would pass the cloth to the second craft maker. The second craft maker then would pull and knot the sewing thread (step E and F). A lot of craft makers in that areas consider that working collaboratively is a faster way to finish the entire cloth rather than working individually.

A different stitch-resist sequence performs by the craft makers in Banjarmasin. They perform step E and F on after sewing each individual pattern. It means the sewing thread is being pulled and knotted on each individual pattern with the needle still attaches on the thread. By doing it this way, the craft makers in Banjarmasin thought that they could save some sewing threads. This sequence allows them to cut the sewing threads straight away after pulling and knotting, and then to continue on the next pattern. This sequence is applicable for the Banjarmasin craft makers because the traditional Banjarmasin patterns (see Figure 4.7) do not require a combination technique with *jumputan* technique. An application of *jumputan* technique is advised to apply in a flat fabric since it is more difficult to apply if the fabric had been pulled and crimped.

The third finding, some areas choose a different type of materials for sewing thread, which are the craft makers in Banjarmasin use threads, the Palembang craft makers opt for synthetic raffias, and some craft makers in Yogyakarta use both threads and synthetic raffias. The use of threads appears to agree with common practices that explain in chapter 2, while the use of synthetic raffia can be linked to the culture in Indonesia.

As it was mentioned before in section 4.4, one of the reasons the craft makers in Palembang use synthetic raffia is to maintain the signature trait of *pelangi* cloth (Figure 4.19a). The other reasons are the synthetic raffia has a slippery surface which makes it easier to pull. The synthetic raffia is also cheaper compares to thread because the synthetic raffia width can be torn into 3 to 4 strings for the stitching technique and even smaller size, 5 to 6 strings, for the tying technique or *jumputan*. Therefore, for the craft makers

in Palembang, synthetic raffia accommodates better the entire process compares to cotton or polyester thread (Figure 4.19b).

Meanwhile, in Yogyakarta, some craft makers employ the synthetic raffia in combination with a thread solely for securing the resist area. Some of the craft makers feel less confident towards their stitch-resist skills; thus, they required an additional medium to help. In result, the signature holes of stitch-resist dyeing pattern are covered. The craft makers in Yogyakarta does not feel essential to display the holes as their authentic sign compares to how the craft makers in Palembang perceive the marks.

(a)

(b)

Figure 4.19 Example of stitch-resist process in Palembang.

Description: (a) stitched cloth with synthetic raffia on a Dobby viscose fabric; (b) knotted *pelangi* colth (photos were taken during the survey 2017).

4.4.3 Phase 3: Colouration process among the Indonesian stitch-resist dyeing craft makers

As it was discussed in section 2.6, the colouration principle has a strong association with fabric knowledge; it means the choice of dyestuff should match with the fabric's selection. It is one of the essential factors that determine the success rate of stitch-resist dyeing resultant pattern. The colouring application method is also equally important in the whole process, especially to ensure a good colour fastness. Referring back to section 4.4.1, three types of fabric use by the majority of Indonesian stitch-resist craft makers are cotton, silk and viscose. Those three fibre types are collectively employed in all three locations, but each area use a different combination of dyes (Figure 4.20). Cotton and viscose are both cellulosic fibres, which means they can be dyed with the same range of dyestuffs, such as anionic direct dyes, sulphur dyes, VAT dyes, azoic dyes, and reactive dyes (Broadbent, 2001). While, the best dyestuff for silk fibre is acid dyes or reactive dyes (Clark, 2011).

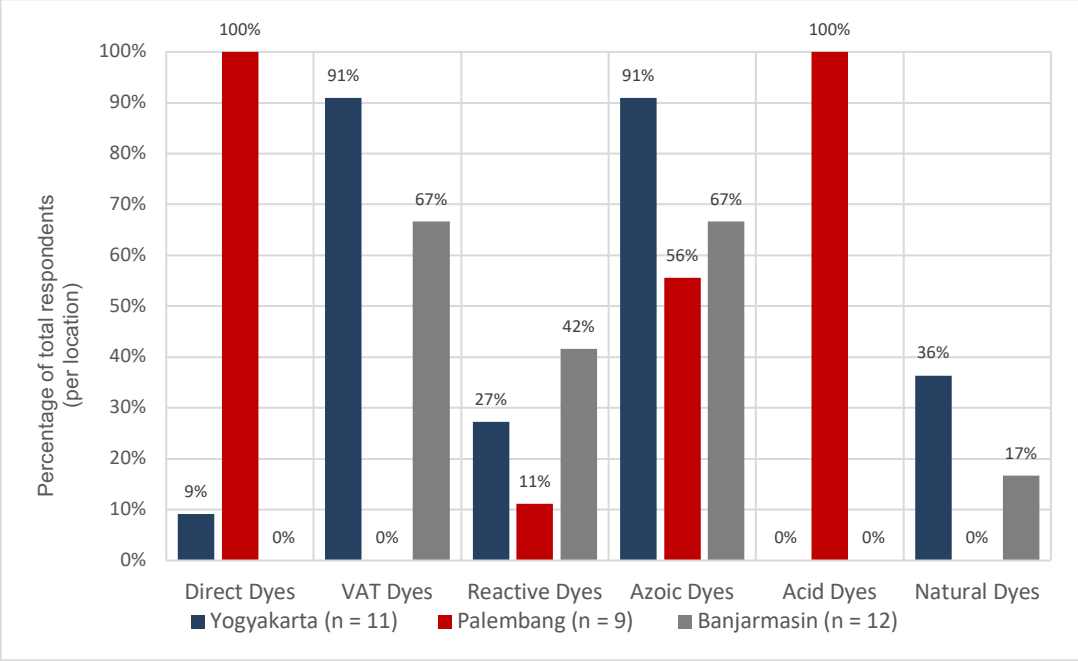


Figure 4.20 The usage of dyes per location on the Indonesian stitch-resist dyeing practices (% of total respondents per location).

Six different types of dyes are recorded among the participants, which are reactive dyes, direct dyes, acid dyes, VAT dyes, azoic dyes, and natural

dyes. The use of different dyes per location is presented in the graphic above (Figure 4.20). Overall, the natural dyes are less popular than synthetic dyes among the Indonesian craft makers, especially in Palembang, due to its complicated process, the long duration and lack of natural dyes supplies in that area. Among five synthetic dyes, azoic dyes are the highest usage in all three locations, and reactive dyes are the second popular dyes among the Indonesian craft maker.

In terms of the number of dyestuffs, the craft makers utilise a variety of dyestuffs on the stitch-resist dyed cloths. Commonly, the craft makers employ different dyestuff on one piece of fabric to provide different colour effects. On average, craft makers in both Palembang and Yogyakarta combine two to three types of dyes within each enterprise. While the craft makers in Banjarmasin use fewer combination than two kinds of dyes on average. Wider variety does not imply a high colour exploration because a high variation is possible in one type of dyestuff if applying in multiple methods.

Specific types of dyes and methods are required for every type of fibres. In practice, the colouring methods of stitch-resist dyeing in Indonesia are classified in two categories: (i) hot dyeing process which is the exhaust dyeing, an immersion of the stitched cloths into a dyeing solution; and (ii) cold dyeing process which is an implementation of specific dyes that only require a low heat water throughout the dyeing process. Different type of tools, such as brush, sprayer, and sponge are utilised in the cold dyeing process by the Indonesian craft makers. Each method is carried out separately or simultaneously, with different methods create and add variations of colouring effects on the pattern. The following discussions describe each category of method in relation to fabric selection and resultant pattern characteristic in Indonesian stitch-resist dyeing.

4.4.3.1 Hot dyeing process (the exhaust dyeing)

The hot dyeing process or exhaust dyeing process is utilised by almost all Indonesian craft makers. The majority of the craft makers practice with a combination of minimum two techniques and one of them is invariably an exhaust dyeing process. Exhaust dyeing process in Indonesia is carried out on a batch basis where some fabrics are immersed in a dye solution for a

particular length of time. The exhaust dyeing process in all three areas utilise moderate and unspecific equipment, such as pots, stove, spatula, big buckets, and spoon. The exhaust dyeing process requires specific temperature for different dyes, but the control heating tools are almost not existed on the dyeing appliances in Indonesia. The Indonesian craft makers control the temperature by observing the natural signs, such as bubbly water and vaporisation on the water surface; or by feeling the water temperature manually. The Indonesian craft makers use the big pot to mix the dyes liquor and heat it on the stove as the time requirement (Figure 4.21). Some personal protective equipment (PPE) are utilised by some craft makers, although not in a complete set.

Figure 4.21 Hot dyeing process or exhaust dyeing process by the craft makers in Palembang (photos were taken during the survey 2017).

The hot dyeing process is mostly used as a dyeing method for reactive dyes, direct dyes and acid dyes. Reactive dyes and direct dyes are applicable for the cellulosic fibres (i.e. cotton and viscose), while the acid dyes are for the

protein fibre (i.e. silk). Reactive dyes are employed in all three areas, with the distinction that most stitch-resist dyeing craft makers in Palembang and Banjarmasin regions use procion, while in Yogyakarta region they use remazol. Palembang is the only location that uses acid dyes, yet all three locations manufacture silk fabric for the stitch-resist dyed cloths. The other two locations employ reactive dyes to colour silk fabric, although acid dyestuff is the most applicable with silk fibre (Clark, 2011). Palembang is the only region that makes significant use of direct dyes. Direct dyes are recognised as a dye class that is relatively easy to apply, but yields lower fastness quality goods, in particular, to wet treatment (Broadbent, 2001). However, the craft makers stated that they do not concern too much about the colour fastness because the existing customers are accepted the possibility of colour fading when purchasing the stitch-resist dyed cloths. Instead of demanding a higher quality colour fastness, most users of the traditional cloths would prepare themselves for the colour bleeding in the first couple of washes, and also the colour brightness degradation that might happen after that.

4.4.3.2 Cold dyeing process

The second category, cold dyeing process, is referred to any techniques that do not require a heating instrument throughout the dyeing process. In Indonesia, the application methods and tools are varied from immersing the stitched cloths into a dye solution in a vat or bucket, stroking with brushes or sponges, and spreading out with a sprayer. Two most frequent type of dyes implemented by the cold process are azoic dyes and VAT dyes; although, applications of reactive dyes with this type of process are also noted among the practices.

All three locations make use of naphthol dyes, as one of the azoic dye class, even though these dyes have become increasingly uncommon to apply on cellulosic fibres because of the popularity of reactive dyes. Napthol has an excellent bright depth, in particular, orange, red, and *bordeaux* hue range (Shore, 1995). The colouring method with naphthol dyes presumably were introduced on the trainings by the instructors who most of them are specialised in a *batik* process. The azoid dyes are the most suitable dyes for the *batik* process because it would not melt the hot wax during the colouring process. All of which together may have contributed in the existing naphthol

dyes application among the Indonesian craft makers. Although, many of respondents have gradually decreased their usage of azoid dyes and have started to replace them with reactive dyes.

Figure 4.22 Application of cold dyeing process by immersing the cloth to a dye solution in buckets in Banjarmasin (photo was taken during the survey 2017).

VAT dyes are used exclusively in the Yogyakarta and Banjarmasin regions, but they use a different brand. Banjarmasin utilises indanthrene dyes and Yogyakarta uses indigosol dyes. VAT dyes are a relatively expensive dye class, and their application process requires strict control for reproducible results (Choudhury, 2006). Although Vat dyes, particularly on cellulosic fibres, give the best overall fastness properties (Broadbent, 2001). Therefore, some craft makers in Banjarmasin and Yogyakarta consider the use of VAT dyes as their selling points from other craft makers.

Both application of azoic dyes and VAT dyes require two stages to form the colour (see section 2.6); however, the Indonesian craft makers implement both processes with different methods to produce different aesthetics. The use of azoic salt in naphthol dyes is modified by combining one type of salt with two or more napthol solution to produce different shade. Therefore, some of craft makers consider naphthol dyes as a low-cost dye. The application of naphthol dyes among the Indonesian craft makers is commonly carried out with a vat or bucket (Figure 4.22), but it is not limited

to that method. The craft makers in Palembang utilise the azoic dyes (naphthol dyes) in different way. First, the fabric is immersed in a salt solution but the diazonium ion solution is sprayed into the cloth (Figure 4.23). The latter method results a hazy gradation between areas that hit by the salt solution and areas that does not.

(a) (b) (c)

Figure 4.23 Colouring method of naphthol dyes with sprayer.

The figure consists of three steps of applying naphthol dyes with sprayer: (a) Immersing the stitched cloth in a salt solution, (b) Setting up the cloth on flat surface, (c) Spraying the diazonium solution on the cloth (photos were taken during the survey 2017).

The two stages of applying VAT dyes starts by immersing the cloth into a vat of dyes solution and then accommodating an oxidation process of the leuco forms of the VAT dyes. It means, the stitched cloths would change the colour after it has been taken out from the VAT solution and contacts with the air. Regularly, the fabric needs to be spread out as quickly and flatly as possible to ensure that the oxidation is even (Wells, 2000), however, the craft makers in Yogyakarta realise this characteristic and take an advantage from the crimped surface of the stitched cloths to create an abstract effect from uneven oxidation process (Figure 4.11b). With VAT dyeing, the shade of a

fabric is determined by how many times the cloths are dipped into the vessel and for how long (Wells, 2000). There is also a feasibility to apply these dyes with sponge or brush, as another variation of methods (Figure 4.24).

(a) (b) (c)

Figure 4.24 Practices of applying cold dyeing process with brushes.

Location: (a) Yogyakarta; (b) and (c) Palembang (photos were taken during the survey 2017).

The colouring process could be repeated many times depending on the intended pattern. The repetition can also across both processes, the hot dyeing process and the cold dyeing process. Step G in the *chaine operatoire* diagram (Figure 4.13) illustrates a diagram of three different types of colouring process in creating the Indonesian stitch-resist dyed cloths. That schematic representation from Figure 4.13 is recreated in this section to obtain the focus of discussion (Figure 4.25). Each sequence is presented with different colour of arrows: grey, pink and orange. Each type of colouring sequence covers all type of dyes. If the sequences conclude the use of naphthol dyes in either on step G2 or step G4, both colouring steps (salt and naphthol solution) are counted as one step. Each variation of sequences is mostly defined by the intended pattern involved, skill/knowledge and also material availability. The following discussion explains each variation with

the application on the resultant patterns of stitch-resist dyed cloths in related location.

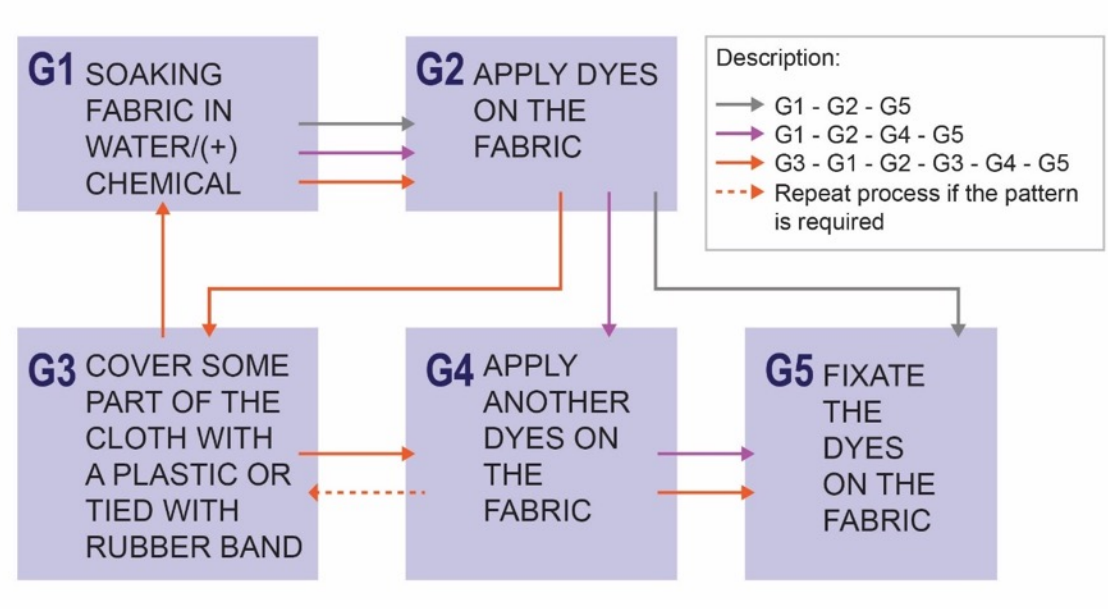


Figure 4.25 Schematic of four different types of colouring sequence among the Indonesian stitch-resist dyeing craft makers.

First sequence is represented by grey arrows, consists of three steps: G1 – G2 – G5. This sequence only involves one dyes application, which means the resultant cloth only has two colours: the original colour and the dyes colour. This composition is referred as a monochromatic colour combination and mostly practiced in Yogyakarta. This sequence can be conducted by hot process and cold process with all form of dyes. The example of resultant pattern using this sequence is the *jumputan* cloth in Figure 4.1a. This sequence could be an additional sequence from the entire stitch-resist dyeing process. It usually occurs at start, if the craft makers want to change the original greige fabric colour into an intended shade before applying the entire stitch-resist dyeing sequence (steps A-H).

The second sequence, presents with pink arrows, is the most frequent process found among the Indonesian stitch-resist dyeing practices. This colouring process sequence is existed in all three locations, but the resultant pattern shows dissimilar artistic visual. The sequence has four steps, G1 – G2 – G4 – G5, which means two colours combination is included in this

sequence. A large number of practices of this sequence consist a combination of exhaust dyeing for step G2 and cold dyeing for step G4. The step G2, exhaust dyeing, aims for colouring the background colour (or a large area), and step G4 aims to give an accent on certain or minor area. The latter aim usually applies by using brushes (Figure 4.24a) or sponges. There are also some possibilities to apply this sequence with both cold dyeing process, ignoring the proportion of background and foreground, majority and minority areas. This sequence could be conducted by immersing the cloths directly in two vats or plastic buckets sequentially, creating an abstract multicolour; or by using brushes, creating more organised systematic multicolour (Figure 4.24b). Any procedures are feasible to create a nice colour composition, as long as the sequence starts from a lighter colour then overlays with darker colour.

Figure 4.26 An example of conduction step G3: cover some part of cloth with plastic (photo was taken during the survey 2017).

The third sequence is considered as a more advance sequence, involving more steps and additional mediums. The sequence has five steps, G3 - G1 - G2 - G3 – G4 – G5, where G3 is the key step in this sequence. The step G3 aims to cover certain area (commonly a large area) of the cloth with plastic bags or tie with wide rubber band (Figure 4.26). They usually utilise the worn soft part of car tyres to employ this sequence. This order is mostly carried out by the craft makers in Palembang, to create the contemporary pattern of

Pelangi cloth (Figure 4.4). The contemporary design is consisted of wide area without any patterns. That plain area is covered first with plastic bag to avoid any contamination from other dyes. The craft makers then colour the stitched area by mostly the cold dyeing process, using brushes (Figure 4.24c). Once the colour has been fixed and dried, the craft makers remove the plastic area from the undyed area to the dyed one. The plain area then colours using the exhaust dyeing process with the other area insides a plastic bag (Figure 4.21a and Figure 4.21b). The order can be conducted interchangeably between colouring the plain area and the stitched area, depends on the pattern and also other colouring demand. The Indonesian craft makers prefer to conduct a significant number of cloths in one dyeing process, therefore they always manage the schedule of dyeing process as effective as possible.

4.4.4 Phase 4: Finishing process among the Indonesian stitch-resist dyeing craft makers

This phase has three steps that categorised into the unknotting process and finishing process. The revealing process is executed after the colouring and finishing process. This step is most likely conducted by a group of housewives, who lives around the stitch-resist dyeing practices. They tend to deliver the task in group without any fixed location because the task does not require specific setting (Figure 4.27).

There are a couple selections of tools noted in the practices across three locations. Seam ripper or small scissor seem to be the recommended tool for this process, if it refers to a basic rule for releasing stitches in sewing task. However, some craft makers employ some alternative tools such as big scissor, large cutter and nail clipper. The use of large scissor or cutter for a very delicate work appears to be problematic because it increases the chance of the fabric getting ripped or torn.

The craft makers in Banjarmasin prefer to use nail clipper to cut away the knot. The practice is considered as a misused of nail clipper, but practically it has helped the process faster. Although, the chance of the nail clipper to rip or tear the fabric is still very high in comparison with seam rippers or small scissors.

Figure 4.27 Typical situations of revealing process by the unknotter groups (photo was taken during the survey 2017).

The finishing process includes washing, drying and flattening the unknotted coloured fabrics. The finishing process does not require any specific treatments, it is very similar with common hand-wash procedures. Once the cloths have been flattened with iron, the cloths are being inserted into a packaging and are ready to be sold to customers. The ironing process is optional based on customer preference. Some customised customers, usually the ones ordered scarfs, prefer to keep the crimped texture from the stitch-resist dyed and tie-dyed processes. They consider the texture as an extra charm of the stitch-resist dyed scarfs.

4.5 Indonesian stitch-resist dyeing craft industry as a communal work

A craft practice usually involves a highly craftsmanship skill to produce a high-quality craft product, looking high on the individual craftsmanship skill on the entire process (Risatti, 2007; Sennett, 2009; Schaefer, 2013). The craft industries in Indonesia are differed, as they are strongly rooted in a community base and mostly consist of communal works. This has been implicitly mentioned on previous sections, throughout the explanation about the craft stitch-resist dyeing practices in Indonesia. The following sections analyse further about the organisational structures that establish among the Indonesian stitch-resist dyeing craft makers.

The existing organisational structures have been successfully arranged and managed the significant works between the craft makers. In these cases, the purposes of establishing a structure are to make sure the entire process is conducted effectively and achieved the end goal; which is producing fine and marketable stitch-resist dyed cloths. The structures on every location are not set by the craft makers in the beginning, it is established naturally due to the increase of demand. Some people take an initiative to set up a home industry type, mostly to encourage the women empowerment in the surroundings.

A depth understanding about how the craft makers operates their practices would give a great advantage to analyse the best suitable revitalisation strategy for them. It considers as a critical and comprehensive analysis of the creative ecology which is part of a process in defining the revitalisation strategy based on the culturally significant products, processes, and people (Evans et al., 2017). Therefore, the soft system methodology is selected to reveal the unstructured soft systems among the Indonesian stitch-resist dyeing craft makers (Patching, 1990). The following discussions commence with first, explaining the history of craft industry establishment in each location. Second, descripting the working culture and values between the Indonesian craft makers. Third, defining the roles existing in each area, and lastly, describing different organisational structures that have established in each location.

4.5.1 The transition from individual practice to craft industries in the Indonesian stitch-resist dyeing practice

As it was explained in preceding sections of this chapter, the custom making of the stitch-resist dyed cloths has been existed for a considerable period of time in three areas in Indonesia. However, the craft industry that manufactures stitch-resist dyeing cloths has started in different time driven by different factors in each area. The practice of manufacturing *pelangi* cloths in Palembang has been conducted in prolonged years. The longer duration of established enterprise among the survey participants was 30 years, but the person has learnt the technique from his parents which was recorded started in around 1979. The parents were also learnt from the established enterprises at that time, so the practice should have been started before that. It was very unfortunate that the official record had not be

found. Although, considering the trading history between India and Indonesia, it is reasonable to assume that the practice has been conducted much earlier than 1979. The existing craft makers in Palembang are the second family generation of stitch-resist dyeing makers, who mostly gain their knowledge by passing the skill from generation to generation. All the stitch-resist dyeing enterprises in Palembang are located in one region, called Tuan Kentang regions. The supporter roles, such as the stitcher and the knotter, are situated in surrounding area within one-mile radius. The majority of the enterprise's owner have a family relationship, and occasionally share the orders among them. Interesting in this particular aspect, the current craft makers in Palembang are originally from Java, they are not a native Palembang people. Their parents migrated to Palembang, as part of a massive transmigration programme during 1970, and started working in some enterprises at that time. Not long after, they took over the business, and the native Palembang people later only involve mostly as the stitcher or as the retailer.

In contrast, the *sasirangan* craft industry started as an initiative by community for women empowerment in 1982, inspired by the success of *pelangi* cloth craft industry. Looking the potential of transforming the *pamintan* cloth, the Banjarmasin initial community learned the technique from the *pamintan* craft makers and then requested a formal training from the local government. Eleven craft makers were chosen to receive trainings about design, colouring process, production management, marketing and branding as part of the Banjarmasin Department of Industry and Commerce programme. Those initial participants were expected to be the pioneers who could transfer the knowledge and start creating more job opportunities in their area. After almost forty years, the industry has expanded into more than hundreds of craft makers now. The industry is centralised at first in the Seberang Masjid region, as it was the centre of *pamintan* cloths practices, then spread out into other regions outside the Banjarmasin city. That initial area becomes the *Sasirangan* village for tourism, providing outlets for the craft makers to sell their cloths. Some of the craft makers now are the second generation of *sasirangan* makers.

Similar with Banjarmasin, the stitch-resist dyeing craft industry in Yogyakarta is started as part of local government programme for women empowerment. The courses that were delivered to the Yogyakarta communities is part of a government intervention to revitalise the technique in Yogyakarta that has

gradually vanished. Since the Yogyakarta area is well-known with *batik* practice, the stitch-resist dyeing technique in this area has been embedded to the *batik* practices. The programme began in 2010 and was formed in a small cooperative group of women. They are expected to collaborate and then share the profit between the group members, which almost exclusively are females. The practices are centralised in the Tahunan hamlet, which now is claimed as the *Batik Jumputan* village.

The entire process of making a stitch-resist dyeing cloth is not accomplished by one person; it is a collective work from many people. Indonesian stitch-resist dyeing craft makers are working collectively as small to medium size enterprises (SME) or cooperatives. The scale of SME is a small business with no more than 250 employees; each enterprise usually employs more than 5 craft makers with different roles. The majority of the craft makers in Yogyakarta take this role as their second job, but this role is a main livelihood for the craft-makers in Banjarmasin and Palembang. All the SMEs are regulated under the Indonesia Department of Industry and Commerce (Disperindag). The recorded data from Disperindag in 2016 showed that Banjarmasin has the biggest percentage (54%) of existing stitch-resist dyeing enterprises compare to other two locations: Palembang (32%) and Yogyakarta (14%).

The Disperindag also supports the enterprises by giving them an opportunity for the craft makers to display their products on a fair trade from the national scale to the international one. The Jakarta International Handicraft Trade Fair (INACRAFT) is the most frequent and massive trade fair that the interviewees have been involved among other fairs. INACRAFT was started in 1999 as an initiative to increase Indonesian craft makers' wealth and it has been an effective channel for craft makers to meet buyers from Indonesia and outside Indonesia (INACRAFT, 2019).

The production capacity of each stitch-resist dyeing enterprise is counted with a number of piece of cloths they produce per month. One piece of stitch-resist dyed fabric is commonly produced in a similar size, which is 2 - 3 metres length and 1.1 – 1.5 metres width. Banjarmasin has the highest production capacity per month with average 700 pieces of cloths per month, Palembang produces almost similar amount with Banjarmasin, and Yogyakarta manufactures quite small number in comparison to the other two locations (Figure 4.28). The stitch-resist dyed cloths are sold within the price range from 70,000 – 250,000 IDR or approx. 4 – 14 GBP per cloth depended

on the design. The cloths are distributed to direct customers, the retailers who own boutique(s) or shop(s), and customised customers (i.e. the local Indonesian government and local company). Most of organisations order the cloths in a significant number for their corporate wear that have a specific design requirements and targeted time. This type of order has given the craft makers a new challenge, due to the need of more uniform and consistent patterns. Although, this type of order has been contributed to their economic significantly.

The production capacity is examined further from the cultural aspects. There are some aspects from the survey results that have relation to the number of production capacity, namely the location, respondents' years of experiences, respondents' number of skills, and respondents' age. Those aspects were analysed with Pearson correlation. The result shows a medium correlation between production capacity and years of experiences (0.649); and between production capacity and location (0.572). It implies that the higher years of experiences could relate to the higher number of production capacity. The years of experiences are defined as the establishment of the enterprises. The long-establish enterprises are predicted could gain customer's trust by repeating the orders, developing the customer base and raising the market awareness. Years of experience also relates with the craftsmanship skill that could produce a better-quality product or speed up the process, which could affect a higher number of production capacity.

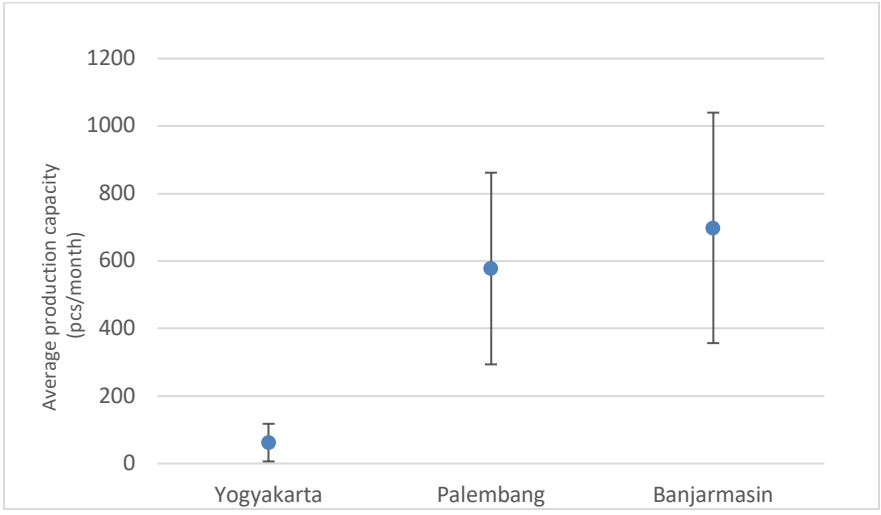


Figure 4.28 Average of production capacity of stitch-resist dyeing enterprises per location.

The practice commonly takes place in the craft makers' residences and merges with their domestic activities. Most of the working areas are not accommodated the process and also safety requirement; especially in Palembang where their residences are only separated with small alley. Lots of dyeing processes take space of the alley, which means the process is accessible for outsiders while passing by. Some craft makers do not want to expand the facility because of economic reason, but some of them prefer to have a close distance between the craft makers so it would be easier for them to help each other. The competitiveness between the craft makers is not evident, since most of the craft makers in Palembang have a family relation. In addition, the working situations in all three places are informal and relax. They do not have a strict working hour, except for the cooperative group in Yogyakarta who has a weekly schedule for the members to conduct the group works. However, the working hour for most craft makers is depended on the order and weather, which means they would work overtime to fulfil a big quantity order and follow the availability of daylight, especially in the raining season.

The craft makers in Yogyakarta are predominantly females, while the number of female and male craft makers in Banjarmasin and Palembang is relatively equal. The majority of the workplaces in stitch-resist dyeing enterprise are part of their residence. This home-based type of works is expected as one of the reasons this work is eligible to be done by women, because traditionally the individual craft activity was considered as women activity on their spare time at home. All the stitchers in the three locations are housewives and they undertake this role in their spare time while managing their domestic matters. There is no male craft makers take part in the stitch-resist process in every location. This situation is expected because this part has a tedious workload but poorly paid. This fact is also supported by the male craft-makers' statement through interview process saying that the 'easy' part of stitch-resist dyeing process such as stitching and knotting, is a female job. Generally speaking, Indonesian textile small to medium enterprises operate on low overheads, narrow profit margins, and often offer limited job security (Hitchcock, 1991). Looking at those conditions, it is expected that the man as a breadwinner of the family prefers a higher income job.

4.5.2 Defining roles in Indonesian stitch-resist dyeing practices (CATWOE)

This section defines the third stage in soft systems methodology, which was the root definition of relevant system. In this stage, the methodology comprises of the mnemonic CATWOE, which constructed from Customers Actors Transformation Worldview Owner Environment. Explanation of each part had been described in section 3.3.4. This mnemonic aims to check all important components that were involved in the stitch-resist dyeing system (Patching, 1990). However, the analysis of each component begins from Transformation and Worldview, since these need to be determined before other components can be properly identified (Patching, 1990); then it continues with Environment, Clients, Owner and Actors.

The transformation is explained as a process which consisted of input and output. The input and output should be in a balanced way, i.e. if the input is tangible form then the output should be the same (Patching, 1990, p.76). In the Indonesian stitch-resist dyeing practice, there are at least two main systems that involved in order to process the input and output. The first system is the manufacturing system, which the input is the greige fabric with certain design (tangible form) then the output is the stitched-resist dyed cloths with requested design (tangible form). The process would be the stitch-resist dyeing sequences, explained in the previous sections. This system is connected with the second system, which is the marketing system. The system is a process of selling the stitch-resist dyed cloths to customers, clarifications of customer needs which is included the design and price. It means, the input is customer needs and output is satisfied customer. The study focuses on sustaining and revitalising the first system; however, the first system would not have been existed without the second system. Thus, the marketing system is considered as a complementary system to the stitch-resist dyeing system.

The worldview is explained about how the system is perceived from a particular viewpoint, which also describes as assumptions made about the system (Patching, 1990). In this case of defining the revitalisation strategies for Indonesian stitch-resist dyeing, the point of view is taken from the concept of sustaining craft community and maintaining the culture behind it. As the impact of globalisation explained in section 1.2.2, the craft world is positioned in a good spotlight; which means more people appreciate the craft product, process, and people. However, this recognition does not

automatically give a great benefit to the craft community. Therefore, examining the system is one of attempts that could help sustaining the society and also the culture behind it.

Table 4.1 Roles in the Indonesian stitch-resist dyeing craft makers.

NO	ROLES	ICON	RELATED PROCESS	TASK DESCRIPTION
1	Entreprise Owner/ Designer			This role was to create the textile design and manage the entire processes for stock or based on order. It also correspond with customers, either selling the goods or taking a customised order.
2	Group leader			This role was to manage the entire processes for stock or based on order. It also correspond with customers, either selling the goods or taking a customised order.
3	Fabric Cutter			A person who divides the fabric into specific required lengths.
4	Drafter			This person was the one who either created a new pattern or composition (designer), or replicated the design by creating a stencil for each pattern and then drew the pattern on the cut fabric with pencil or pen (drafter).
5	Distributor		N/A	This role was a connnector between the owner and the stitchers. The duty was to distribute and organise work load to every stitcher in one particular village.
6	Stitcher			A person, mainly a housewife, who applies the running stitch by following the pattern outline.
7	Knotter			A person, mainly a housewife, who pulls the sewing thread and then knot it at the end.
8	Dyer			A person who is responsible for the entire colouring process, especially in mixing the dyeing solution. Dyer usually supervises a group of two to three dyers.
9	Dyer's helper			A person who prepares fabrics for the pre-dyeing process, applies the dyeing solution to each fabric, and then applies the post-dyeing process until drying the fabric.
10	Unknotter			A person who releases the knot on the colored stitch-resist dyed textile.
11	Finishing Controller			A person who washes and dries the stitch-resist dyed textile. The quality of the textile then being checked while flattening with iron.This task usually also includes a packaging process.
12	Customised Customers		N/A	People who benefit and utilise the stitch-resist dyed cloths for specific aim, such as: corporate wear and event uniform.
13	Direct Customer		N/A	People who benefit and utilise an available stitch-resist dyed cloths in shop or directly from the workshop.
14	Shop Owner/ Retailer		N/A	People who help distribute the stitch-resist dyed cloths to customer and also get a profit for selling the goods.

The environment in this root system definition is referred to the world that surrounds and influences the stitch-resist dyeing practice but has no control

over it. The world can be translated into political, economic, socio-cultural and technology. In the politic aspect, the Indonesian government has been a good supporter for this craft practices, which is also reflected on the good economic growth for the craft makers in general. It also implies that the government has a strong influence but does not control the system. The situation is quite the opposite on the social-cultural aspect as well as the technology aspect, since the working environment and technology development are considered very poor.

The enterprise owner or group leader is one who benefits from the manufacturing systems. The enterprise owner and group leader also act as the owners which could cause the entire systems to cease to exist. As a communal work, the stitch-resist dyeing practice in Indonesia involves a number of people throughout the system; it means there are lots of people with different roles involve as the actors for this system. The categorisation of roles is generated based on the observation process of individual jobs in the stitch-resist dyeing sequence in the three survey locations. Some of the craft makers could have two or more responsibilities throughout the process. The list of roles is described in Table 4.1 along with the icon that is linked to the next rich pictures, the related process from the sequences and also the task description.

4.5.3 The organisational structure of Indonesian stitch-resist dyeing practices

The roles are similar in each location of stitch-resist dyeing practice but operate with different workflows. To understand the complex pattern of workflow in each location, diagrams had been created using the rich pictures tool from soft system methodology. Rich picture is structured based on respondents' answers to the questionnaires, interviews, and observations. The analysis of CATWOE on section 4.5.3 also determines the shape of rich pictures in each location. As a communal work, there are two different organisational structures employ among Indonesian stitch-resist dyeing craft makers: enterprise and cooperative. Each location shows some similarities and minor differences at certain points. The following discussions describe those two types of organisational structures and also explain some distinctions on each location.

4.5.3.1 Enterprise structure

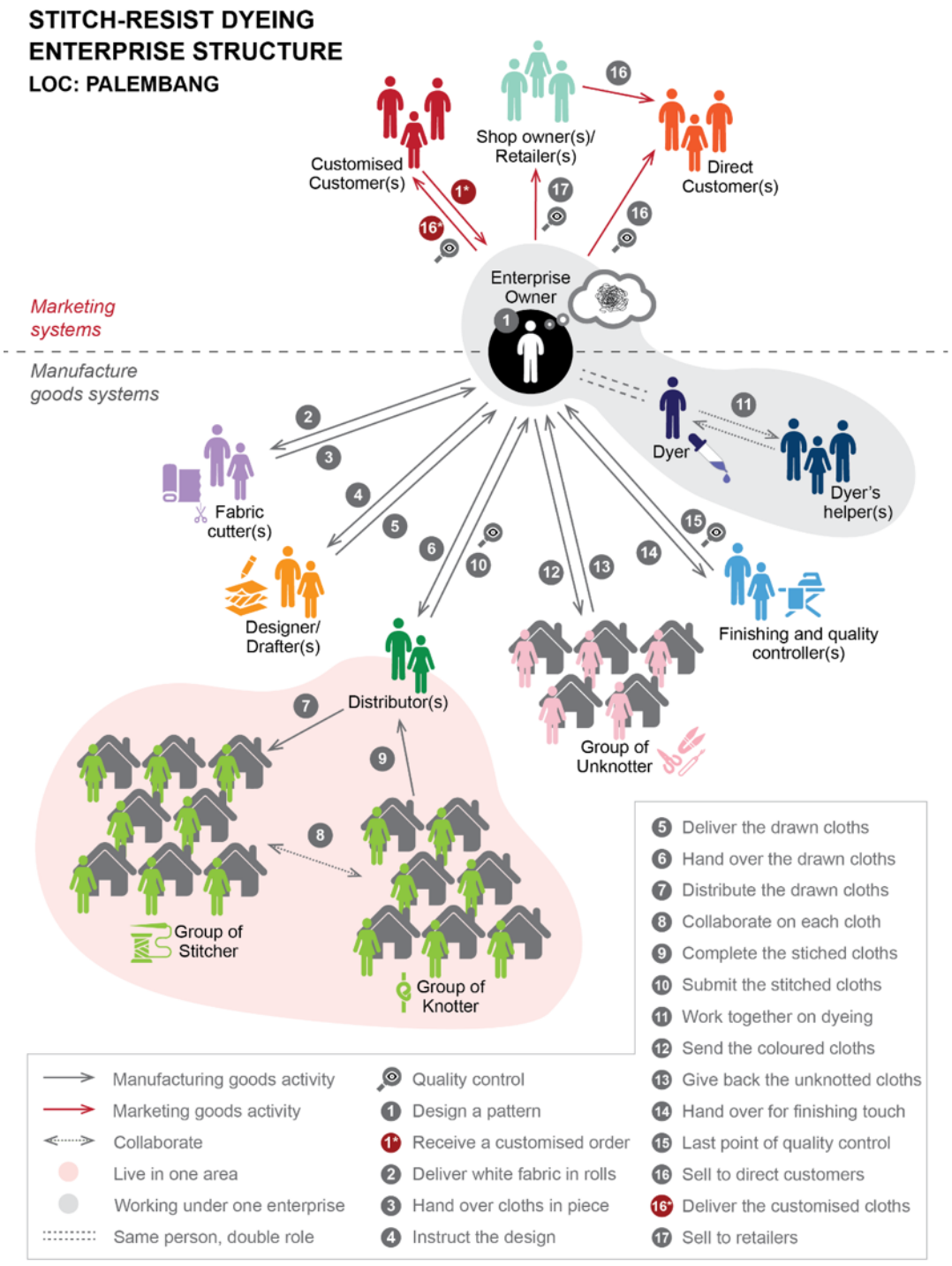


Figure 4.29 Enterprise organisational structure among the stitch-resist dyeing craft makers in Palembang.

Man, girls, fabric, iron board, groups of people, knotting, sewing tools icons made by Freepik from www.flaticon.com.

The enterprise type of stitch-resist dyeing practices show a proper and more distinctive production line compare to the cooperative type. It gives the advantage to produce a bigger quantity of goods, but it also threatens a high possibility of producing lower or more inconsistent quality goods. In this workflow, the enterprise owner acts as a leader in the system, organises and manages all the process based on the customer needs and customised order.

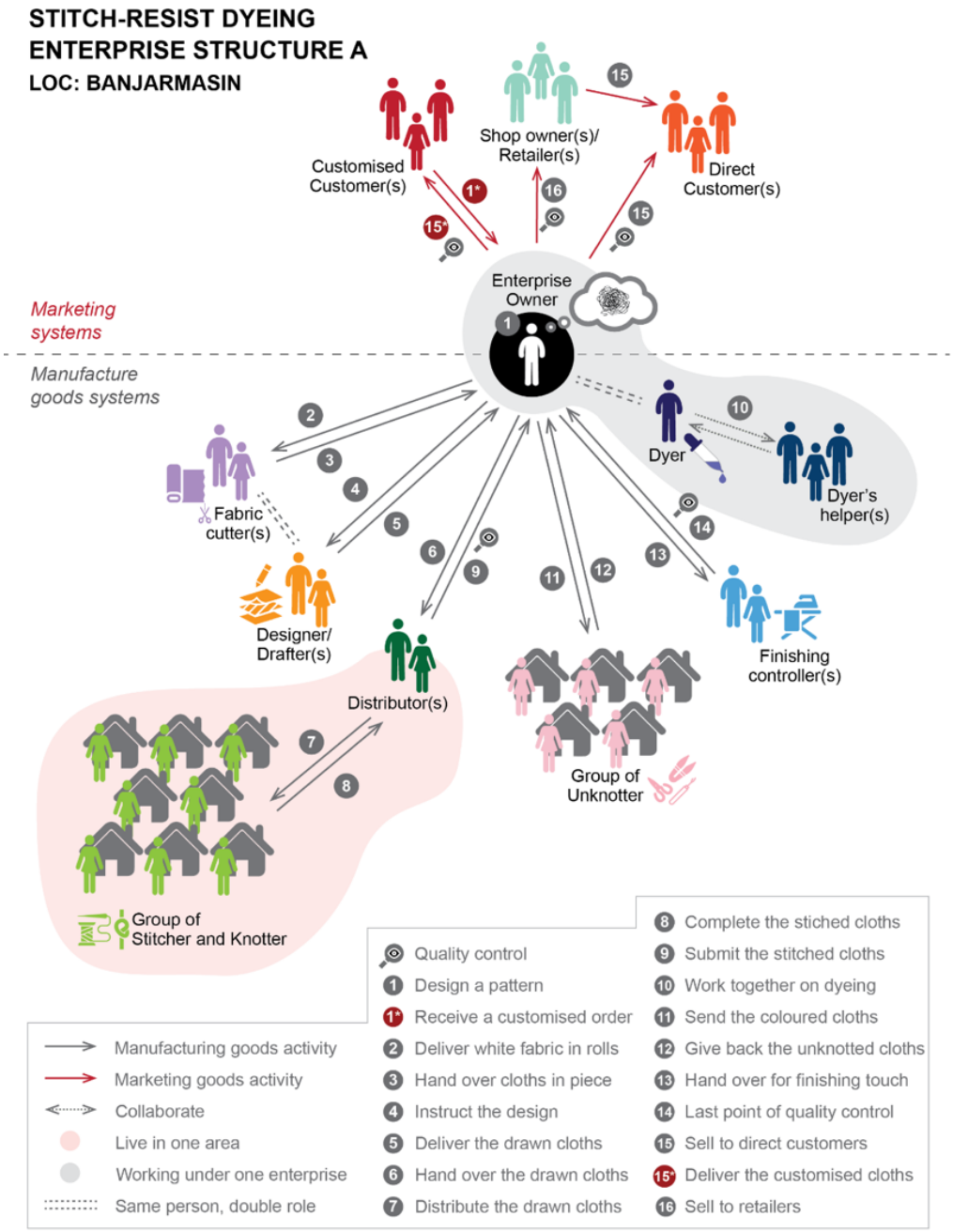


Figure 4.30 Enterprise organisational structure type A among the stitch-resist dyeing craft makers in Banjarmasin.

Man, girls, fabric, iron board, groups of people, knotting, sewing tools icons made by Freepik from www.flaticon.com.

The rich picture of enterprise structure in Palembang is presented in Figure 4.29, and the definition of each process is presented on the legend. In this structure, the enterprise owner acts as a multiple role and positioned in both manufacturing systems and marketing systems. This situation can possibly cause a disarray mind, especially when the order increases. Although, some roles of enterprise owner are supported by the dyer's helpers (2 – 3 persons) and also stitcher distributor. The distributor allocates the workload to every stitcher in one particular village. The stitchers have no access to the enterprise owner in this organisational structure, even though they are an acquaintance. In this case, the authority and the responsibility of the quality (the regularity of stitch length and tightness of knotting) of stitching process is belonged to the distributor. Based on the design, the stitch-resist processes can be conducted by an individual or by collaboration of two craft makers (see Figure 4.18). Those two craft makers divide their tasks as one person sew and the second person pull then knot. Some of the craft makers assume that this task arrangement accelerates the process duration since each person only does one part at the time. The knotted fabric then is delivered back to the enterprise owner by the coordinator.

Banjarmasin establishes two types of enterprise structures. The rich picture of the first enterprise structure is displayed in Figure 4.30. This structure has a similar arrangement with the Palembang enterprise structure. The only different is there is no separate groups in conducting stitch-resist process, all steps are done by one person. It is also not very common to sell the cloths to a retailer, the owner tends to commerce the cloth to the direct customers if it is not the customised order.

The rich picture of second enterprise structure in Banjarmasin is illustrated in Figure 4.31. In this organisational structure, there are two leaders on each system. The enterprise owner plays a main role in the marketing system with a focus on how to earn more capital, while the dyer leads the manufacturing system with a focus on delivering a good cloth based on the enterprise owner order. The workload on the enterprise owner is less compare to the enterprise owner on the first structure. In this case, the owner also focuses more in clarifying customer needs, in terms of design, material, trend, and

price. However, it is also important for the enterprise owner to understand the whole process in creating a stitch-resist dyeing design.

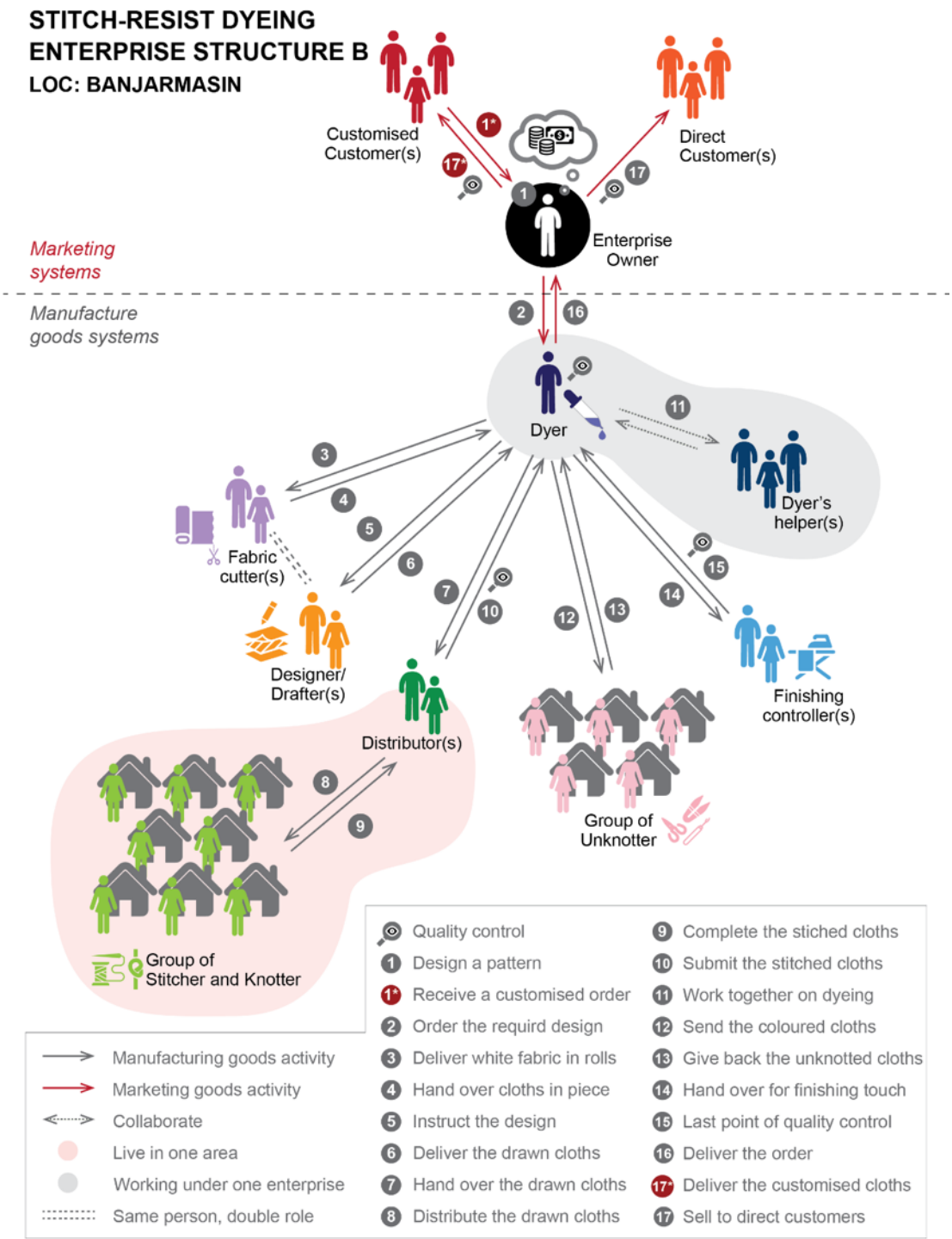


Figure 4.31 Enterprise organisational structure type B among the stitch-resist dyeing craft makers in Banjarmasin.

Man, girls, fabric, iron board, groups of people, knotting, sewing tools icons made by Freepik from www.flaticon.com.

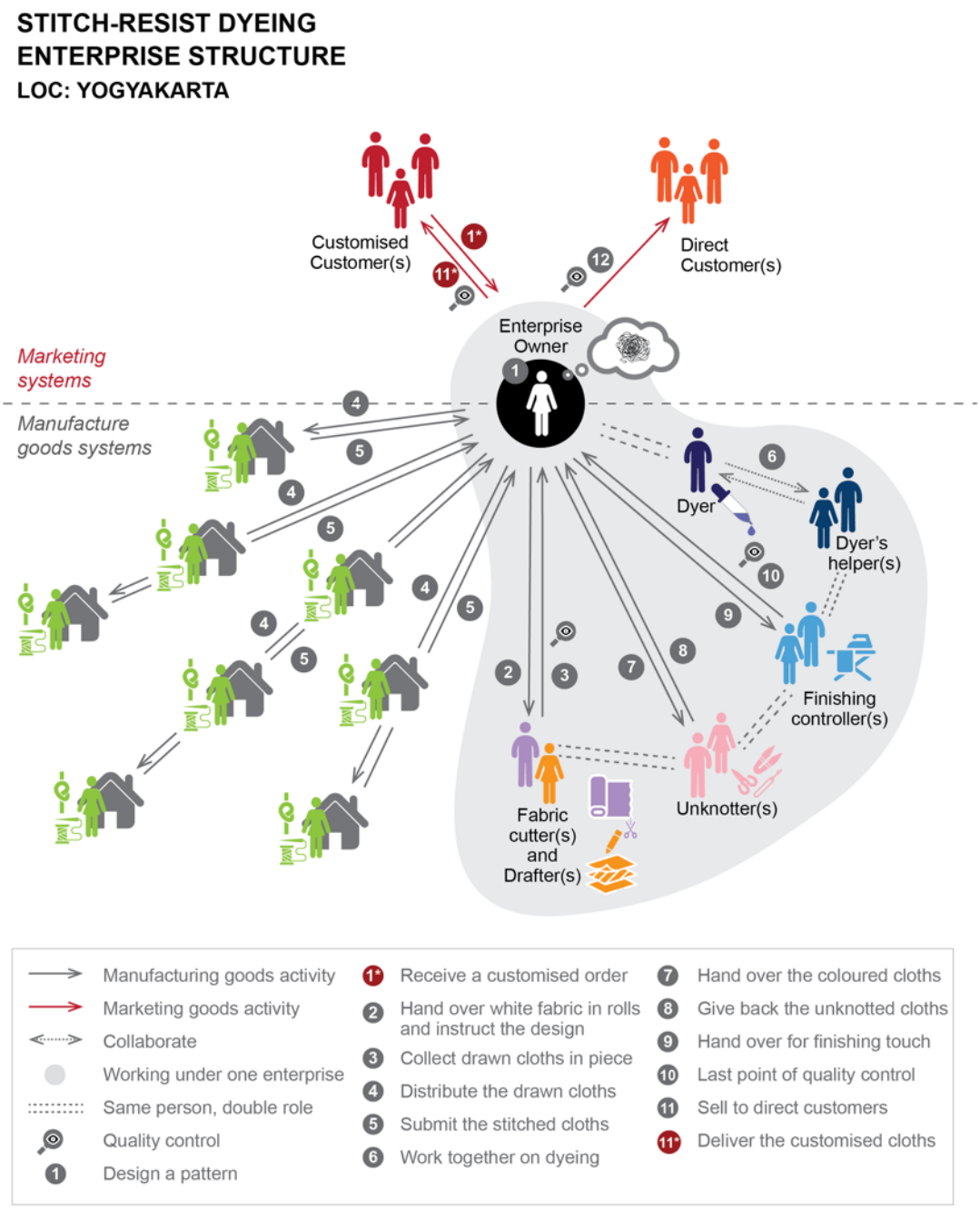


Figure 4.32 Enterprise organisational structure among the stitch-resist dyeing craft makers in Yogyakarta.

Man, girls, fabric, iron board, groups of people, knotting, sewing tools icons made by Freepik from www.flaticon.com.

The enterprise structure in Yogyakarta is formed in a smaller size of enterprise (Figure 4.32). Most of the actors work under one enterprise, unless the stitcher. The stitchers, which also the knotters, conducts the role independently in their house and corresponds directly to owner. The

permanent enterprise employees usually have multiple roles, to make the enterprise size smaller. This aspect gives a benefit for the owner because it means less tasks to handle and more profit. However having multiple roles can also reduce the level of productivity from on each role.

4.5.3.2 Cooperative structure

The cooperative structure in Yogyakarta is illustrated in Figure 4.33. Eight out of the eleven organisational leaders who were interviewed for the study conduct the practice with a cooperative type. The majority members of the group are housewives who work in their spare time. In this workflow, the role of group leader has a responsibility to manage the product supply, to handle the order and deliver the order to the group members. The orders usually are placed from organisations to create their corporate wear. Commonly, the entire processes, except the stitch-resist process, are conducted together once or twice a week at a regular place as their headquarter. The stitch-resist process is done by all members on their own house during the week. Each member has at least one role when they are gathered, and an additional role when they are at home. The profit gained by this group is calculated every month and distributed equally to each member.

The cooperative system in Yogyakarta has a greater chance to produce a better quality considering the fact that every member is involved in the entire process. Furthermore, the profit is distributed equally among the members, even though only group leader who in contact directly with the customer. Thus, each member has the same responsibility to deliver the best quality of work. This workflow creates a more professional working environment among the craft makers whilst still maintaining the teamwork. However, the cooperative structure in Yogyakarta needs to have a longer establishment to prove this proposition.

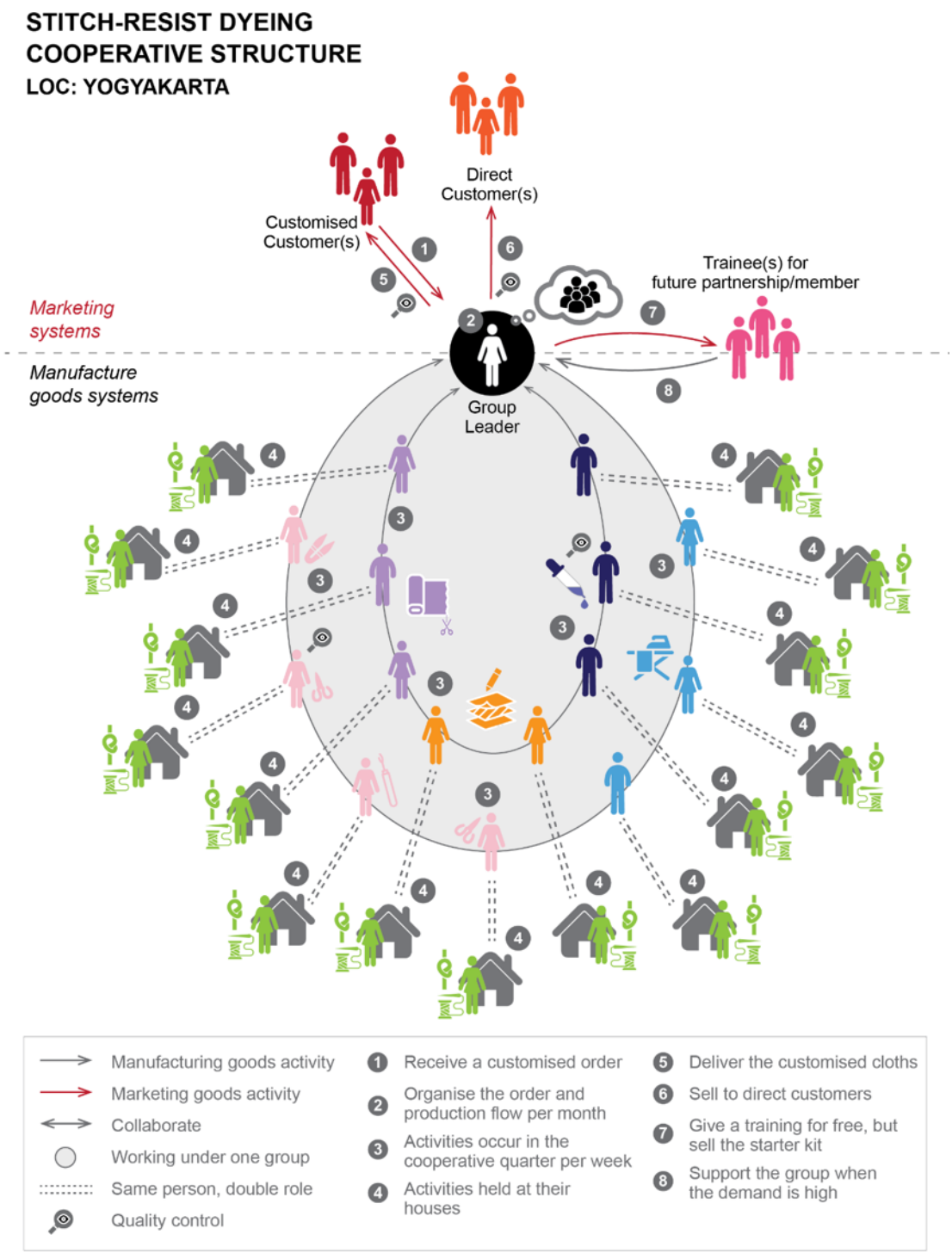


Figure 4.33 Cooperative organisational structure among the stitch-resist dyeing craft makers in Yogyakarta.

Man, girls, fabric, iron board, groups of people, knotting, sewing tools icons made by Freepik from www.flaticon.com.

4.6 The transformation effects of the Indonesian stitch-resist dyeing practices based on the survey

After analysing data from the entire elements of the practices, respondents were asked if there are any obstacles in practising the stitch-resist dyeing technique as a craft industry up until now. This part aims to understand the crucial part of the practice from the user perspective, and what issues that should get more attention in the near future. The issues that are presented in here are based on the fifty-seven enterprise owners or group leaders answers from the seventy-seven respondents. The enterprise owners are considered as the person who understand the entire process of manufacturing textiles using the stitch-resist dyeing technique. Each respondent has options to deliver more than one issue by choosing multiple answers in the questionnaire. Their answers are presented in the next diagrams (Figure 4.34).

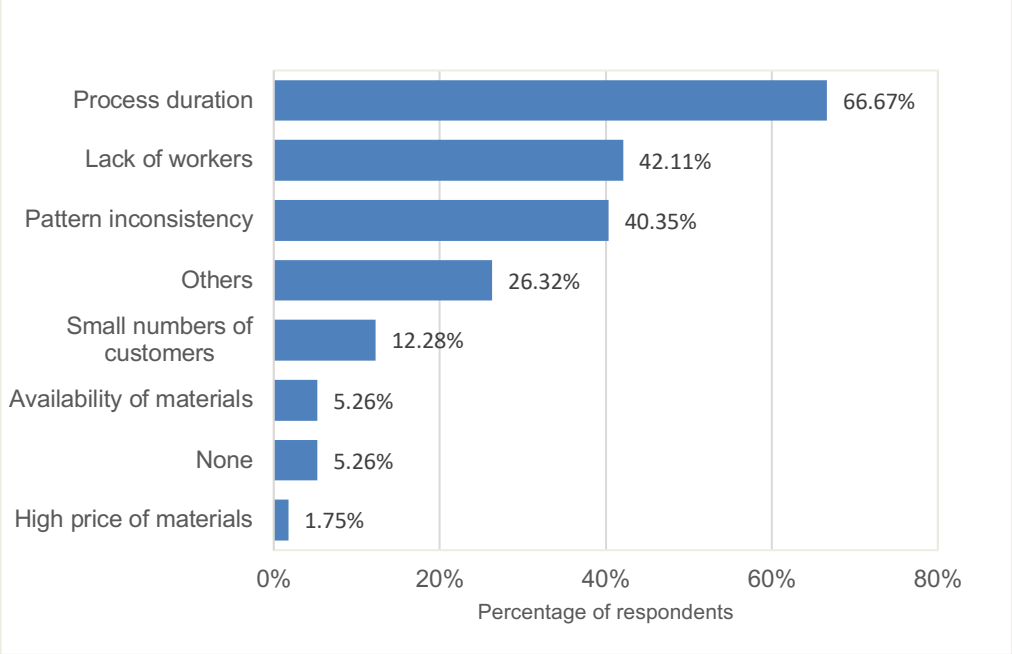


Figure 4.34 Issues on the stitch-resist dyeing practices based on the respondents (n = 57).

From the diagram above and the explanation from the interviews about that matters, there are four issues mentioned by the craft makers that could be classified into two categories: production issues, and social and cultural

issues. The production issues are covered the issues about process duration and also pattern inconsistency; while the social and cultural issues are the low quality of craft makers' life issues. The latter issue is referred to the lack of workers issues and the other issues that came as the fourth highest issues in Figure 4.34. The other issues are explained further in Figure 4.35. The following sections discuss each section individually.

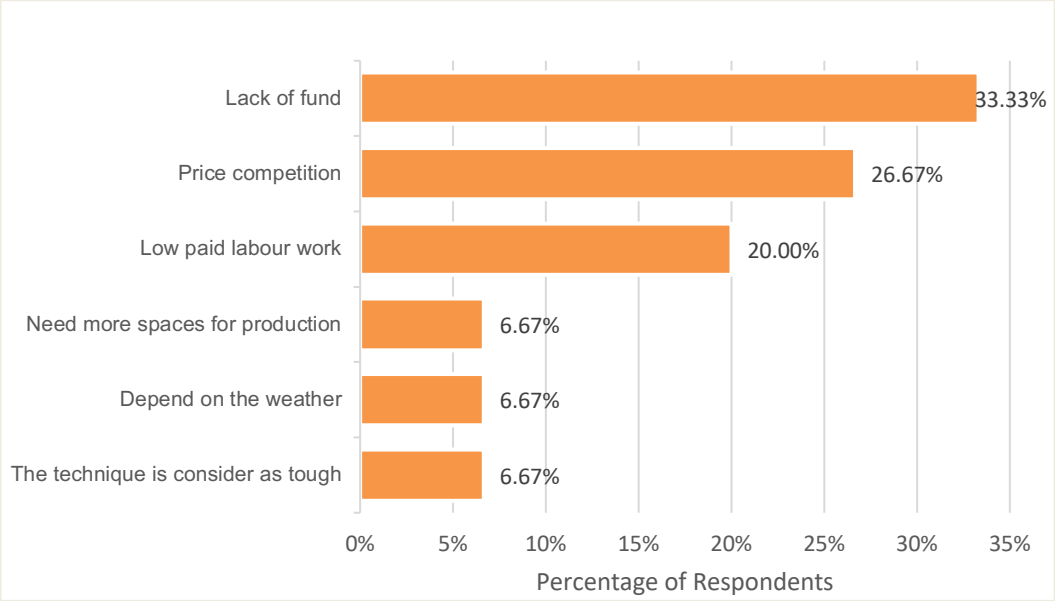


Figure 4.35 Other problems on stitch-resist dyeing practices based on the respondents (n = 57).

4.6.1 Production issues: pattern inconsistency and time consuming

More than half respondents stated that the duration of the process was one of the critical points on these practices. The manual process of the resist mechanism (stitching, pulling, and knotting) is considered as time-consuming. However, examining the organisational structures, the unpredictable time taken by the workers to finish their tasks is also contributed to this issue. Mostly for the female crafter, namely stitchers, knotters, unknotters, and members of the cooperative, their role comes as a second priority after their main obligation being a housewife. The domestic responsibilities in their household sometimes leads to the delay of the work; which the crafter could not be blamed for that reason, due to the informal relationship between the roles. The family relation between employees is

also contributed to a high tolerance level that affects the time delivery and also causes the inconsistent quality. The effect from employing synthetic raffia in order to make the sewing and knotting process easier and faster in is considered insignificant because they are still facing the similar issues in terms of duration.

Pattern inconsistency issues is defined as different pattern results caused by the ineffectiveness of the resist mechanism process (Figure 4.36). It was explained further from the interviews that this issue might happens for several reasons, such. As seen in observation process, the knotting mechanism has been modified in Yogyakarta craft maker by combining with tie-dye mechanism. This attempt happens because the craft makers consider the knotting mechanism as the hardest part. The second issues that are related to pattern inconsistency is torn fabrics (Figure 4.37). The torn fabric is caused by errors in the revealing process which could be seen as lack of craftsmanship skill or application of inappropriate tools. The inappropriate tools are referred to the miss function of devices, or the difficulty to see the thread considering that the cloth is already in the colourful condition by the time it needs to be cut.

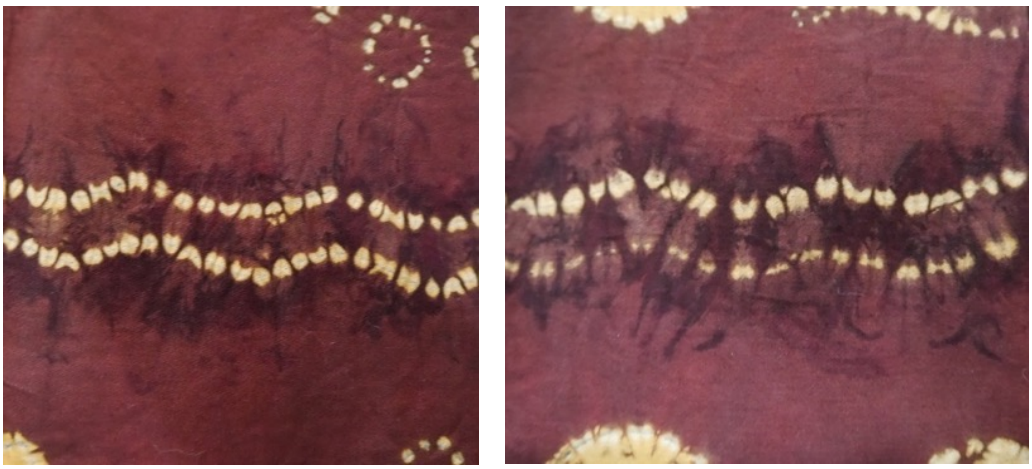


Figure 4.36 Example of pattern inconsistency caused by the loose on knotting process.

Description: Left image is an approved pattern, and right image is not an approved pattern.

Figure 4.37 Example of torn fabric caused by lack of craftsmanship skill or application of inappropriate tools.

4.6.2 Social and cultural issues: low quality of craft makers' life

The low-quality life of the Indonesian craft makers stroke as an important issue based on the survey. Most of craft makers consider their wage to be lower than average, or in other words, they could not support their family only from this role. These issues do not arise from the enterprise owner, but mostly from the stitcher. As taking the important role from the entire process, the stitcher role has been overlooked on this practice. The low wages can also happens from a high number of people involved throughout the process of making each cloth.

The issue with price competition is also related to the wage of each craft maker. Price competition is described as an inconsiderate action from some craft makers to reduce the cloth price in order to reach the market. This action has been depreciated the value of goods, which also could come from the customer side. In reality, the appreciation of traditional cloth is not as comprehensive as the theory explained in section 1.2.2. This situation has been described by Triharini (2014) as a cycle that creates the problem: "the buyer wants cheap crafts; the middlemen sets the production margin; the craftsperson has to finish on time; the craftsperson has less time to work; details are neglected; low quality crafts are produced; and crafts are sold at a low price." The middlemen in the stitch-resist dyeing practices is the enterprise owners or group leaders. They are expected to break the cycle with raising the bargaining position of the stitch-resist dyed cloths.

Presumably, this low wage issue has a strong related with the lack of workers issue. Lack of workers is described further as the deficiency of manpower to speed up the process. The lack of workers originates from the fact that younger generations have more interest in modern than traditional matters (Chudasri et al., 2012). In addition, the insufficient amount of money to support their needs reduces the level of attractiveness for the younger generation to involve in this process. This situation could jeopardise to the continuity of stitch-resist dyeing practice in Indonesia, which means losing the culture.

4.7 Summary

This chapter has provided a comprehensive of the commercialisation impact on the culture, the technical aspects, and the organisational structure that were related to the stitch-resist dyeing practices in Indonesia. The study indicated that stitch-resist dyeing was employed differently in each location, based on the artefact and the sequences. It was shown that the selection of method, tools, sequences and materials made by the craft makers affect the result of the stitch-resist dyed cloth, and vice versa. The commercialisation supported by the Indonesian government has changed the culture among the craft makers. Several issues have been pointed out regarding this matter, and pattern inconsistency was considered as a very important and singled out as the main focus for revitalising the stitch-resist dyeing technique because the highest demand for this practice was for corporate wear. A further examination of this part of stitch-resist dyeing process should be conducted to have a deeper understanding of the cause of patter inconsistency.

In summary, the majority of craft makers in Palembang initially learned the technique from their family and then gained more knowledge from training. While the craft makers in Banjarmasin and Yogyakarta rely on courses or training to learn the technique. The Indonesian government or private companies mostly provide the courses as part of their Corporate Social Responsibility (CSR) programme. The training usually covers not only in the technical side such as designing a new pattern, colouring technique, production management, but also in the business area, such as marketing, branding and sales management.

From the discussion on this section, the problem in process duration and inconsistency pattern stated by the respondents is related to resist and revealing the mechanism. The issues have caused the craft makers in decreasing number of productions since they have rejected products. Up until now, the craft makers encounter the problem by selling the defect cloth with lower price or turning it into products that only required fewer textiles, such as pillowcase, skirt, tablecloth, and bags. In that case, they could avoid the defect area, and the fabric is still valuable.

Although, this issue can be solved by improving the resist and revealing mechanism; thus, the pattern is expected to be more consistent and less time-consuming without losing the originality of the pattern. The improvement of this part of stitch-resist dyeing process covers of these technical factors of the sewing threads, such as strength, friction level, thickness, colour, extensibility, and cost. The resist mechanism should be easy, either in knotting or revealing mechanism, for the housewives so it can produce a high level of repeatability with the same tension. This issue is considered very important and singled out as the main focus for revitalising the stitch-resist dyeing technique because the highest demand for this practice is for corporate wear that requires uniformity.

The majority of craft makers are not following the proper mechanism of the dyeing procedure, based on the survey of Indonesian stitch-resist dyeing practices. They tend to conduct the process with a pragmatic method, the trial and error procedure. The equal access for the fabric in the dye solution and temperature during dyeing process is questionable because the craft makers do not measure precisely the components that related with the process (i.e. the weight of the fabric, amount of water, the amount of dyestuff, temperature, and duration). Thus, the dyeing process could be the cause of poor colour fastness and inconsistent result in Indonesian stitch-resist dyed cloths. However, the correlation between them needs to be investigated further with different methodology since accurate data was unlikely possible to be developed by only asking the craft makers. Thus, the following chapter describes the experiment method conducted in this study to fill the gap in the correlation between key factors of stitch-resist dyeing technique and the resultant pattern.

Chapter 5
Experiments on the Indonesian stitch-resist dyeing key factors and their effects on resultant patterns

The survey findings discovered significant knowledge about the Indonesian stitch-resist dyeing practice. In addition, many publications have described the key factors of this technique (Maile, 1969; Belfer, 1972; Larsen et al., 1976; Singer and Spyrou, 1989; Wells, 2000), and have inspired and guided people to create a different kind of stitch-resist dyed patterns. However, the correlation between the key factors and how they affect the resultant patterns has not been well explored in the previous publications, and the Indonesian craft makers left insufficient records about that topic. Therefore, this chapter aims to examine the correlation between critical factors of the Indonesian stitch-resist dyeing technique and the resultant patterns. If successful, this study can help to address the pattern inconsistency issue faced by the Indonesian craft makers.

The stitch-resist dyeing technique is considered as a tacit knowledge category where high craftsmanship skills play a prominent factor to produce successful patterns. A defective pattern sometimes called “a happy accident”, is usually defined as a handmade characteristic. However, the happy accident situation is not always acceptable in some conditions. As mentioned in the previous chapter, the Indonesian craft makers have struggled to produce patterns to fulfil the most prominent contemporary demand: corporate wear. The demand requires a consistent, uniform and repeatable pattern. The pattern is considered defective if it has faulty pattern shape or colour or if some parts of the cloth are torn. The Indonesian craft makers suggested that the loose knots, the uneven pleated fabrics, or the use of an inappropriate tool could be the problem. Therefore, understanding the correlation between all factors can potentially identify the causes of said faulty.

The experiment and discussion are structured in six sections which comprise an explanation of the experiment method, followed by the experiment results and then an analysis of the data. The first section (5.1) explains the experiment variables, then follow by the experimental procedure in the next section (5.2). The third section (5.3) describes the dyeing experiment output.

The next section (5.4) comprise the first data analysis method: an objective measurement with the DigiEye instrument tool and MATLAB programme. The fifth section (5.5) discusses the second analysis: a visual perception study. Subsequently, results and analyses from both methods are discussed to understand the correlation between the influential factors with resultant patterns in the stitch-resist dyeing technique. The last section (5.6) provides a summary of this chapter.

5.1 Defining variables in the stitch-resist dyeing experiment

Defining the right variables for the experiment is a major factor in a successful experiment. The hypothesis in determining the variables and conducting the experiment was based on the literature review and survey result. The experiment attempted to replicate the Indonesian stitch-resist dyeing technique as much as possible for this experiment to be relevant to their practice. The dependent variable is the resultant pattern which was evaluated based on the pattern clarity and user preference. The experiment has three independent variables which are hypothesised to be key to determining good pattern clarity. These independent variables were stitch length, depths of shade and tightness level. The constant variables in this experiment were the selection of materials and the colouring method, including the type of dyeing process and the selection of dyes. The selection of materials, fabric and thread, and the colouring process were generated from the Indonesian practices, based on the findings in section 4.4.3. The outline of all variables relating to this experiment had been described in section 3.5.3 (Table 3.1).

Primissima fabric is fine and light cotton manufactured in Indonesia, specifically in Central Java and Yogyakarta area. The reason this material was selected is because this fabric is very popular among Indonesian craft makers. *Primissima* fabric is very popular because it suits to the Indonesian weather very well and is popular with customers. It is also easy for the craft makers to work with the *primissima* fabric since it contains a natural cotton fibre with a high number of threads. The fabric construction of *primissima* cotton used in this work was plain weave with thread count 133 epi and 72 ppi, and had been bleached, mercerised, and sanforised. The selection of thread was based on the survey result and availability, and it was

automatically followed by the selection of needle size. The explanation of other variables is described in the next sections (5.1.1 – 5.1.3).

5.1.1 Stitch properties

Indonesian craft makers believe the quality level of stitch-resist dyed cloth rely on the stitch length consistency which also determine the pattern and craftsmanship quality. Small and consistent stitch length is considered as a good pattern and shows high craftmanship skill or years of experience. In order to create consistent small stitches, the stitcher needs to use their extraordinary tacit knowledge. The only exception was an authentic *sasirangan* pattern, *hulat karikit*, which requires a large stitch length to create a good pattern. *Hulat karikit* is a specific pattern comprising of three parallel zig-zag lines (Seman, 2008). Maile also mentioned the length of stitch as large and small (Maile, 1969). Titisari (2012) discovered in her experiments that the stitch length should not be longer than 5mm. However, the aesthetic appearance differences within small and large stitch length have remained unclear. Furthermore, the question arose where the limit of acceptable pattern and the unacceptable pattern is. This experiment aimed to respond to the ambiguous situation by quantifying the pattern clarity by a triangulation approach.

The pattern for this experiment was a straight line, which is a fundamental element in all Indonesian stitch-resist dyeing designs. The sample layout had been described in section 3.5.3 (Figure 3.10). The initial experiment was conducted to determine the suitable stitch length between 2 mm, 3 mm, and 4 mm. The experiment employed a stencil board to transfer the design, imitating the Indonesian stitch-resist dyeing practices. The result showed that the 1 mm increment was too small for a significant visual difference in pattern appearance to be perceived. The 2 mm stitch length was hard to execute because the needle insertion points were too close to one another. Therefore, 3mm was selected to represent small stitch length and 5 mm as large stitch length.

5.1.2 Tightness parameter for knotting

The other matter that the Indonesian craft makers stated as being important was the way of knotting. To produce a good pattern, the sewing thread

needs to be knotted at both end until the fabric is gathered very tightly. However, the pressure parameter has not yet been explored. One method that has been used until now is by checking if the sewing thread is still showing or not between the pleated fabric (Maile, 1969). The hidden sewing thread is a good indicator that the thread has been sufficiently tight. This presumption is logically acceptable but not measurable. This experiment aspired to provide a quantifying indicator to give a standard measurement of the tightness level between the two knots.

The pressure on the pleated area was considered as one of three important factors to create a clear stitch-resist dyeing pattern. The initial pressure test was conducted with the Titan Universal Strength Tester equipment. The sewn, gathered and knotted fabric is inserted within the Titan equipment, so that the bottom and top piece of the sewn fabric are held securely within the jaws with the sewing line perpendicular to the jaws. As the test progresses, the jaws are moved apart at a steady rate and the tension in the sewing line that results is measured by the equipment. At the end, it was difficult to measure the pressure. The result showed that the knotted thread has unstable strength, where the tug from the Titan machine can tear the fabric, allowing the thread to slip through the needle insertion points. This phenomena could have happened because the position and the size of the knots allows it to slide between warp and weft threads or breaking the structure of the warp or weft yarns, by snapping either or both yarns. As a conclusion, the test was not the right method to check the pressure on the knotted thread. It was also not applicable for the dyeing experiment since the fabric was tended to be destructed after the strength test.

Since pressure or force could not easily be quantified, this experiment employed the tightness level of the knotted thread as the parameter. Tightness level was defined as the degree of compression on the fabric after being pulled and knotted, which was established by setting and/or measuring the length between the start knot and end knot. The pattern length automatically shrinks after the thread is being pulled and knotted because the length is divided into pleats. The pleats place two fabric surfaces directly against one another, and the force from the knotted thread gives the compression in that area that resists the dye penetration. The smaller distance between the two knots on the thread implies a higher level of compression between the pleats of the fabric. There were three steps to measure the tightness level of the knotted thread: (i) measuring the fabric

thickness; (ii) calculating the number of needle punctures on the pattern area; and (iii) setting the tightness level.

The first step was to determine the fabric thickness of the cotton *primissima*. The fabric thickness was measured using the Shirley thickness gauge, following the British Standard procedure (BSi, 1997). This procedure was conducted under two specified conditions, which are: first, the fabric was conditioned in standard atmosphere (temperature of 20,0 °C and a relative humidity of 65,0 %) for 24 hours prior to the measurement (BSi, 2005). Second, the correct pressure was calculated by measuring the diameter of the presser foot on the gauge. The diameter of Shirley thickness presser foot was 80 mm, so an applied pressure of (1 ± 0,01) kPa is recommended. With a calculation of 1 kPa = 10.197 g/cm^2, the weight needed on the presser foot was 500 grams. The measurement was taken on five different areas on the fabrics with five times repetition for each location for 30 seconds each time. As a result, the thickness of the cotton *primissima* was established at 0.2 mm (Table 5.1).

Table 5.1 Table of fabric thickness measurement result using the Shirley thickness gauge.

Area	Attempt 1	Attempt 2	Attempt 3	Attempt 4	Attempt 5
I	0.20 mm	0.19 mm	0.20 mm	0.20 mm	0.21 mm
II	0.20 mm	0.20 mm	0.19 mm	0.20 mm	0.20 mm
III	0.20 mm	0.20 mm	0.20 mm	0.20 mm	0.20 mm
IV	0.20 mm	0.19 mm	0.20 mm	0.20 mm	0.20 mm
V	0.23 mm	0.19 mm	0.20 mm	0.20 mm	0.20 mm
Mean	0.206 mm	0.194 mm	0.198 mm	0.200 mm	0.202 mm

The second step was calculating a number of pleats creating by pulling the thread on the pattern area, which was a 165 mm long straight line. By knowing the specific stitch length, the number of needle puncture points can be calculated with this equation: (pattern length/stitch length) + 1 = the number of needle puncture. The number of needle puncture points represent the number of fabric surface that are contained by the knotted thread. That number is also linked with the number of dots that are produced from the stitch-resist dyeing technique. For this experiment, the number of needle

puncture points for 3 mm stitch length was 56 puncture points, and for 5mm stitch length was 34 puncture points (see Figure 3.10). It can also be translated that within this pattern, fabric samples with 3 mm stitch length would have 56 small circles at resisted area after the whole dyeing process, and the 5 mm stitch length fabric sample would have 34 small circles.

The last step was setting the tightness level parameter for this experiment. As mentioned previously, the tightness level between the two knots is directly proportional to the length between the two knots. The number of puncture points was multiplied by the fabric thickness to calculate the length between the two knots. The result from this calculation was assumed as a low tightness level which can be quantified as 100% of the length between the two knots. Logically, under these condition, the fabric surface only touch one another's surface without any compression, which means the tightness is loose or low. By decreasing the length between the two knots, the compression between the layers of the pleated fabrics can be increased.

Table 5.2 The measurement of the tightness level parameter.

Stitch length	Low		Medium		High	
	Percentage	Length	Percentage	Length	Percentage	Length
5 mm	100%	6.8 mm	75%	5.1 mm	50%	3.4 mm
3 mm	100%	11.2 mm	88%	9.8 mm	75%	8.4 mm

For this experiment, three tightness level were tested to examine the effect of the compression provided by the knotted thread on the resultant pattern. Those tightness levels were initially defined as low tightness level (100%), medium tightness level (75%) and high tightness level (50%). Length value of each tightness level was calculated using this equation: tightness level (%) x (fabric thickness (mm) x number of punctures) = length of thread between the two knots (mm). There were some adjustments of measurement level on the 3 mm stitch length fabric samples because the 50% of the length between two knots was not applicable to secure. Therefore, the 3 mm stitch length categories had 100% - 88% - 75% tightness levels, corresponding to low, medium and high tightness level respectively. Hence although the tightness level varied for the 3 mm and 5

mm patterns, three levels (low, medium and high) are determined in both cases. The detail calculation of each category is presented in Table 5.2.

5.1.3 Depths of shade

The character of the Indonesian stitch-resist dyeing patterns is multicolour, e.g. the *Pelangi* cloth, translates as rainbow. The shape of the pattern and composition of colour are two variables that play a major role in creating a clear stitch-resist dyeing pattern. However, this experiment is focused on understanding the correlation between the key factors. Thus, the aesthetic factor was removed from this experiment to avoid any bias. The colour element of this experiment did not comprise any colour combination, but it employed different levels of the shade of a single colour to investigate the correlation between pattern colour and background colour. The pattern colour was the original fabric colour, which was white fabric and the background colour was dyed with blue dyes. The blue colour was chosen because it has a wide range of shades (Bleicher, 2012). So, the possibility of the pattern and background to have a variation of contrast value is higher.

The Indonesian craft makers employ a varied type of dyes (see section 4.4.3). The dyeing process is set as a constant variable in this experiment, which means only one type of dyeing process was chosen for the whole experiment. The method selection was considered based on the technique used in the majority of Indonesian craft makers. Almost all Indonesian stitch-resist dyeing makers surveyed utilise the exhaust dyeing process. The majority of craft makers practise with a minimum of a combination of two techniques, and one of them was invariably an exhaust dyeing process (see section 4.4.3). The exhaust dyeing process is usually carried out on a batch basis where some fabrics are immersed in a dye solution for a particular length of time under specific conditions (Maggs, 1990, p.25); the dye transfers from the solution (dyeing medium) onto the fabric's substrate during this period. In terms of dyestuff selection, the majority of the Indonesian craft makers employ azoic dyes and reactive dyes (see Figure 4.20, section 4.4.3). However, the azoic dyes require two stages in colouring process (Broadbent, 2001); it means there are more variables in azoic dyeing reproducibility. Therefore, reactive dyes are a better choice for this dyeing experiment in term of samples reproducibility.

In addition, reactive dyes are also suitable for the exhaust dyeing process on cotton because the dye must have substantivity for the fibre for the dyebath to become exhausted (Broadbent, 2001). Reactive dyes are available on different types based on their reactive groups which affect their application. One type of reactive dyes is the bi-functional reactive dyes which contain two reactive groups for enhancing the possibilities of reaction with the fibre, leading to greater fixation and less hydrolysed dye (Clark, 2011). This experiment employed the Remazol Black B (C.I. Reactive Black 5). The advantage of Remazol Black B was it provides a wide range of light blue to dark blue-black. Therefore, this dye can accommodate the different level of shade by applying a different percentage of dye solution. The successful exhaust dyeing was principally depended on the correct calculation of the amount of dye needed (Wells, 2000). The right calculation facilitates a reproducible dyeing with appropriate fastness properties (Wells, 2000). The choice of depth of shade was based on the sample books from the dye manufacturer. The Remazol Black B has 100% standard strength. An initial dyeing experiment was conducted to analyse the most effective range to show a contrast between 1% depth of shade, 2% depth of shade, 3% depth of shade, and 4% depth of shade. Based on the initial result, the experiment chose only three shades, which were 1% depth of shade, 2% depth of shade and 3% depth of shade because the 4% depth of shade did not show significant differences in terms of colour contrast with the 3% depth of shade.

As mentioned earlier, this experiment was conducted in three batches. This experiment applied reactive dyes by producing stock solutions instead of calculating the amount of dye needed in grams, to have an accurate repetition. By measuring the dyes in-stock solutions, the dyes solution were then applied to the tubes using a pipette for more precise measurement. The volume of dye solution was calculated by using this equation: (Weight of material x % depth of shade) / strength of the solution = volume of dye solution needed for each fabric sample or (W x D) / S = V (Wells, 2000). The average weight of each fabric sample was 1.9 gram, and the dye stock solution was 1%. As an illustration, the volume of dye solution needed was 1.9 ml of 1% dye solution for 1% depth of shade, 3.8 ml of 1% dye solution for 2% depth of shade, and 5.4 ml of 1% dye solution for 3% depth of shade. Remazol Black B dyes require salt and alkali as auxiliaries to enable the fixation of the dyes evenly. This experiment used 20 $g.L^{-1}$ of alkali ($NaCO_3$) and 60 g.L-1 of salt (NaCl), the dyeing profile is provided in Figure 5.2.

5.2 Experiment setup and methods

The experiment was conducted in the School of Design, University of Leeds. The design transfer procedure was conducted at the Chemistry laboratory and the Digital printing workshop. The stitching and knotting process was carried out at the Chemistry laboratory. The dyeing process was conducted in both the Chemistry Laboratory and the Dyeing laboratory. COSHH form for conducting the experiment has been approved by the School of Design Health and Safety Department, University of Leeds.

The primary experiment was conducted in three batches. Two heated chambers on the Roaches Pyrotec 2000 infra-red dyeing machine were utilised simultaneously with each chamber is able to hold up to 9 dye pots filled with the appropriate dye solution and a fabric sample. The samples were categorised based on the stitch lengths, depths of shade and tightness level. Each batch contained six variable combinations with 3 repetitions, thus 18 samples were dyed at the same time on each batch (Table 5.3). Overall, the experiment produced 54 stitch-resist dyeing fabric samples.

Table 5.3 Number of samples on each dyeing experiment batch

TIGHTNESS LEVEL	BATCH 1 1% depth of shade		BATCH 2 2% depth of shade		BATCH 3 3% depth of shade	
	5 mm Stitch length	3 mm Stitch length	5 mm Stitch length	3 mm Stitch length	5 mm Stitch length	3 mm Stitch length
Low	3 samples	3 samples	3 samples	3 samples	3 samples	3 samples
Medium	3 samples	3 samples	3 samples	3 samples	3 samples	3 samples
High	3 samples	3 samples	3 samples	3 samples	3 samples	3 samples
TOTAL	9 samples	9 samples	9 samples	9 samples	9 samples	9 samples

5.2.1 Design transfer procedure

The design transfer process has an essential role in this experiment. This process purposes to apply a precise and consistent stitch length pattern on a

fabric sample without retaining any marks on it after the dyeing process. As mentioned before, this experiment tried to replicate the Indonesian stitch-resist dyeing practice. Indonesian craft makers utilised stencil board to produce consistent patterns (section 4.2.1). However, the Indonesian board was only able to repeat the pattern outline without giving any particular stitch length information. Therefore, the method required some modifications to its procedure to meet the aim of this experiment. Initial experiments were conducted by comparing four different methods of indicating stitch length requirements on the fabric to assess the feasibility of each approach in meeting the objective. The following paragraphs describe the procedure and then evaluate the advantages and disadvantages of each method.

1. Stencil board

The first method employed in this initial experiment was a stencil board. This method was selected mainly because of its similarity in procedure with the Indonesian craft makers. There were two small differences in this method from the Indonesian one. Firstly, the board was produced with a laser cutting method, which employed a precise digital pattern. Secondly, the design was created with a specific stroke line length. This initial experiment pertained with the previous explanation about the initial dyeing experiment which aimed to determine the stitch length variable (section 5.1.1.1). The procedure is explained, below:

1. Create a digital pattern file suitable for the laser cutting machine. The pattern has three different stroke lengths: 4 mm, 5mm and 6mm. The stroke length represented the stitch length.
2. Put a thick board on the designated area.
3. Run the machine. As a result, the board now has a pattern with specific stroke lengths.
4. Put the stencil board on the top of the fabric and draw marks through the stencil holes with a pencil.

There were some advantages and disadvantages of employing this method. The advantage was that the approach could be related more closely with the Indonesian practice. The disadvantages were the method required more than one process (i.e. creating the file, producing the stencil board, and marking the fabric). Thus, the method was more time-consuming. In addition, the resultant mark also was not accurate and consistent. There was

2 mm reduction on the resultant marks. The stencil board that has 4 mm stroke length produced a 2 mm stroke line mark. So do the other measurements, 5 mm stroke length created 3 mm stroke line mark and 6 mm stroke length created 4 mm stroke line mark. The main reason for this length reduction was because the pencil tip was not small enough to reach the edges of each stroke hole. This implies that the exact pencil used in transferring the design to the fabric can have a potentially large and uncontrolled impact on the resulting pattern. This is undesirable so in conclusion, this method could not meet the experiment goal: consistency of the stroke lengths.

2. Laser cutting

This second method was chosen after reviewing the strength and weakness of the first method. The method utilised a laser cutting machine as well. However, instead of applying to thick board, the method processed the laser cutting directly on the fabric. The method did not have any connection with the Indonesian stitch-resist dyeing practice, but it can meet the research objective. It can be considered as an alternative for the Indonesian practice as well. In this method, the pattern employed small dots instead of stroke lines. The procedure is explained, below:

1. Create a digital pattern file suitable for the laser cutting machine. The pattern was small dots in one line with two spaces: 3 mm and 5 mm.
2. Place the fabric on the designated area.
3. Run the machine with two different settings: engraving and laser cutting. Engraving only scorches the fabric surface, while laser cutting creates holes in the fabric.

The first advantage from the laser cutting method was that it is speedy and relatively simple, in comparison with the first method. The second advantage was the exact resultant marks. However, this method had a crucial disadvantage where the marks had burnt effects from both engraving and laser cutting. The burn effect would have affected the resultant pattern, in terms of yarn strength and colour. Therefore, this method cannot be employed because it left marks on the fabric sample.

3. Dye-sublimation printing

Printing became the next option in achieving the goal. In order to leave no marks at the end of this experiment, the printing process should be able to print the pattern in a very small size of the dot. It means, the dyes would have a less strong fixation with the fabric or both. By having less fixation strength, the ink was expected to dissolve during the dyeing process. Dye-sublimation printing opted for the third method. A Mimaki JV150 dye-sublimation printer was selected because it has a minimum ink droplet size in 4 pico litres (pl). Pico denotes a trillionth part, which means it can create a high-resolution printing (MIMAKI, 2019). The very tiny printed dot would disappear when the needle punctured the fabric. The detail of the procedure is explained, below:

1. Create a digital pattern file suitable for the dye-sublimation printer. The pattern was small dots in a line.
2. Print the pattern in a specific paper, then place the fabric on the top of the paper.
3. Insert both paper and fabric into the calendar machine and then run the machine.

This method gave great benefit in terms of time length and precision and was able to print 1610 mm as its maximum width. However, the high heat burnt some of the fabric area because the machine was initially designed for a synthetic fabric. With a natural fibre, such as cotton, the printing reacted with some areas created a large brown stain mark. Thus, this printing method cannot be employed for the experiment.

4. Inkjet printing

Another selection from printing method was the inkjet printing with the Fujifilm Dimatix Materials Printer (DMP-2850). The Dimatix printer is built for Research and Development (R&D) and feasibility testing, because of the small printing area up to 8x11 inch or A4 substrate. Compare with the Mimaki dye-sublimation printer, this machine took longer time, and it can be considered as a disadvantage. However, this machine has two advantages: first, the piezoelectric inkjet technology which produces an outstanding typographical quality; second, the MEMS-based cartridge-style print head

that gives liberty for the user to fill with specific fluids and print immediately (FUJIFILM, 2019). It means that it can print tiny dots and also allows the application of direct dyes. Direct dyes were considered to be the best option among dyestuff for cellulosic fibres because of their wash-fastness performance is only moderate (Clark, 2011). It implies that this method had met the requirement in terms of consistency and stain visibility. The detail of the procedure is explained, below:

1. Create a digital pattern file suitable for the printer software. The pattern was small dots in one line with two spaces: 3 mm and 5 mm.
2. Transform the printing file on the Dimatix software.
3. Make direct dye solution of appropriate concentrations as listed in Table 5.4 and then stir them with distilled water up to 10 grams.

Table 5.4 The solution of direct dye for the Dimatix printer.

Amount	Substance
1 gram	Ethylene glycol
2 grams	Propylene glycol
0.5 gram	Glycerol
0.25 gram	2,4,7,9-tetramethyl-5-decyne-4-diol-ethoxylate (non-ionic surfactant)
1 gram	CI Direct Red 80
5.25 gram	Distilled water

4. Transfer direct dye solution into the Dimatix printer ink cartridge.
5. Cut the *primissima* cotton with a size of three samples: 24 x 24.5 cm. Mark the fabric by the size of each sample: 8 x 24.5 cm.
6. Set the sample fabric on the designated area in the Dimatix printer by placing fabric tapes on critical spots. A printed layout has been set up beforehand on the top of the printed area to make the positioning process easier (Figure 5.1).
7. Apply direct dyes to the sample fabrics by inkjet printing the dye on the fabric according to the predetermined fabric and repeat three times in order to produce a clearly visible pattern.
8. Once the dye has dried, keep the fabric still in three samples layout and proceed the next step.

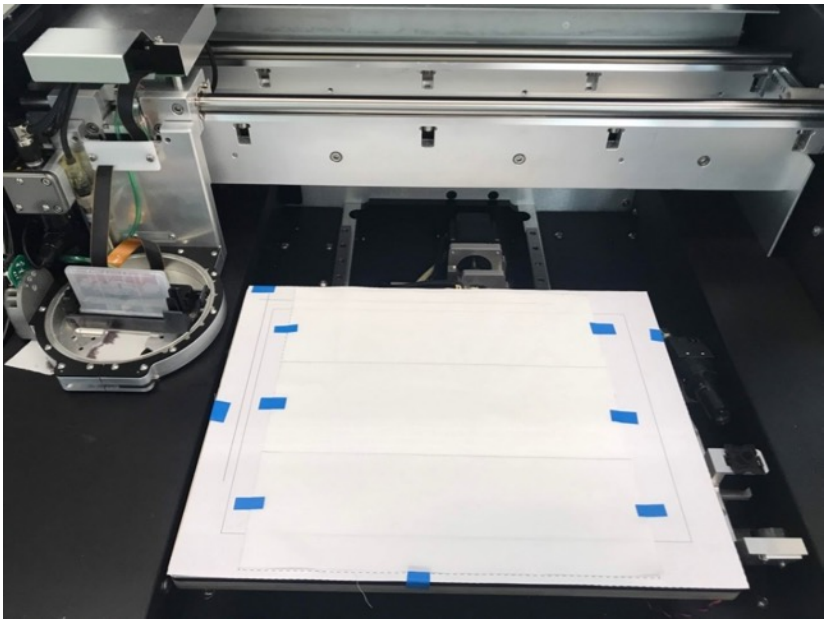


Figure 5.1 Printing process with the Dimatix printer using Direct dyes ink.

5.2.2 Stitching and knotting procedure

Description of the stitching and knotting procedure followed:

1. Applied running stitches using double thread following the straight-line pattern. The start and end of stitching were always in the same position in every sample. Every thread had a similar size of a knot in one end by following the steps described in Figure 4.17 (section 4.4.2). At this point, the other end of the sewing thread was left with an extra length unknotted.
2. After the stitching process had been done on all three samples, cut the fabric within each sample size: 8 x 24.5 cm.
3. Set the three assigned tightness level (see section 5.1.2) on the sewing thread. Measure each thread length corresponding to the pre-determined tightness level from the knot by placing the thread along a pre-marked template and then marking the thread with a permanent marker.
4. Pull the sewing thread on the other end until the mark is visible. Arrange the resultant wrinkle to make sure the fabrics pleats are in place.

5. Knot the sewing thread on the mark by making a basic double knot (Figure 2.10, see section 2.5).
6. Put the stitched cellulose fabric on a scale to measure the dry fabric weight.
7. Write down a sample number in a small plastic label with a permanent marker and then sewed to each sample.

5.2.3 Dyeing procedure

The dyeing procedure (Figure 5.2) conducted was:

1. Prepare all solutions by using 1:60 liquor ratio. The Remazol Black 5 was prepared in a 1% solution; salt was measured in solid grams and alkali was also prepared in 1% solution.
2. Pour sodium chloride (NaCl) in every dye pot and then shake each pot manually with distilled water. The reference dye tube should contain exactly the same volume of liquid as the other dye tubes, to ensure the same temperature throughout.
3. Once the solution has been mixed well, put the sample on each tube with the according number. Securely screw on the lid fitted with the seals.
4. Switch on the Roaches Pyrotec 2000 infra-red dyeing machine and the water supply. Set up the programme from the control panel, as shown in Figure 5.2. There were two chambers on the machine, both were programmed separately, and they run simultaneously.
5. Insert each of the dye pots carefully into the mounts. Make sure they are locked in securely and distributed evenly around the dial. Insert the temperature probe into the receptor carefully and securely hold the probe by the solid metal portion.
6. Once all is set up, run the programme on the machine. When the programme has reached the addition point, add dye solution into each dye pot using a pipette. The similar procedure was applied with the alkali solution.
7. After completing the dyeing process, firstly, carefully remove the temperature probe from the dye pot's receptor using appropriate gloves. Secondly, gently remove the dye pots from the mounts, pressing the tabs to allow them to slide out easily. Then, switch off the machine and the water supply.

8. Take the fabric sample out from each dye pot and rinse it with cold water. Pour out the solution from the dye pot and clean it in the sink.

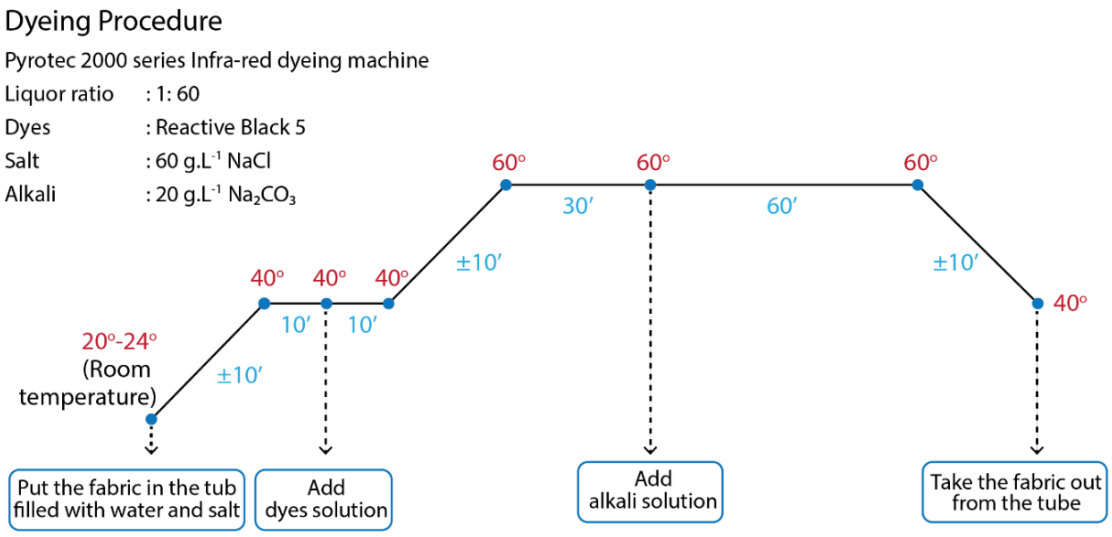


Figure 5.2 Exhaust dyeing procedure for the stitch-resist dyeing experiment.

The soaping procedure (Figure 5.5) conducted was:

1. Prepare a 1% solution of non-ionic detergent (Histapal) in 100ml of distilled water.
2. Pour the 100 ml of mixed of non-ionic detergent and water into each dye pot then put the fabric into it. Securely screw on the lids fitted with seals.
3. Switch on the Roaches Pyrotec 2000 infra-red dyeing machine and the water supply. Set up the programme from the control panel, as shown in Figure 5.3. There are two chambers on the machine, both can be programmed separately, and they can run simultaneously.
4. Raise the cover of the appropriate baths and carefully insert each of the dye pots into the mounts. Make sure they are locked in securely and distributed evenly around the dial. Carefully and securely insert the temperature probe into the receptor, hold the probe by the solid metal portion.
5. Once all id set up, press the start button on the control panel to initiate the soaping process.

6. After completing the soaping process, carefully remove the temperature probe from the dye pot's receptor. Gently remove the dye pots from the mounts, press the tabs to allow them to slide out easily. Switch off the machine and the water supply.
7. Carefully open the lid of the dye pots and take out the fabrics. Rinse the fabric through cold running water from a faucet, then warm water and back to cold water alternately for ± 5 minutes each time. Clean all the dye pots. Dry the fabrics at room temperature on the drying rack.

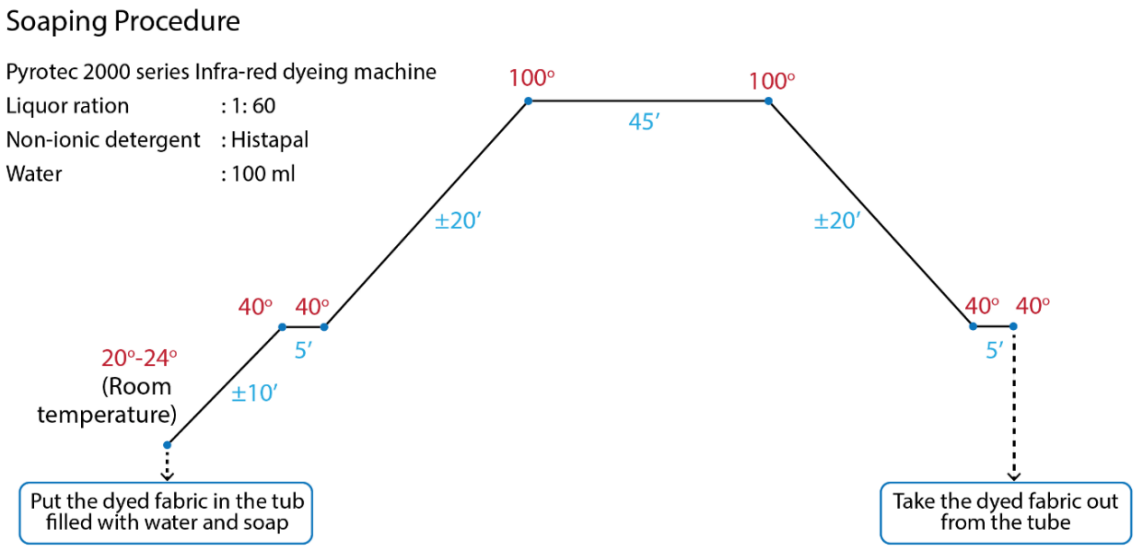


Figure 5.3 Soaping procedure for the stitch-resist dyeing experiment.

5.3 Experiment outputs

There were two outputs from this dyeing experiment: stitch-resist dyeing fabric samples and the residual sewing threads. The fabric samples were analysed with two methods which are explained in the next sections, section 5.4 and 5.5. The residual sewing threads were corresponded to the thread length between the two knots as measured after the unknotting process. The threads were measured by using the same tightness measurement that set in the initial position to examine the stability of knotting position and tightness level during the dyeing process.

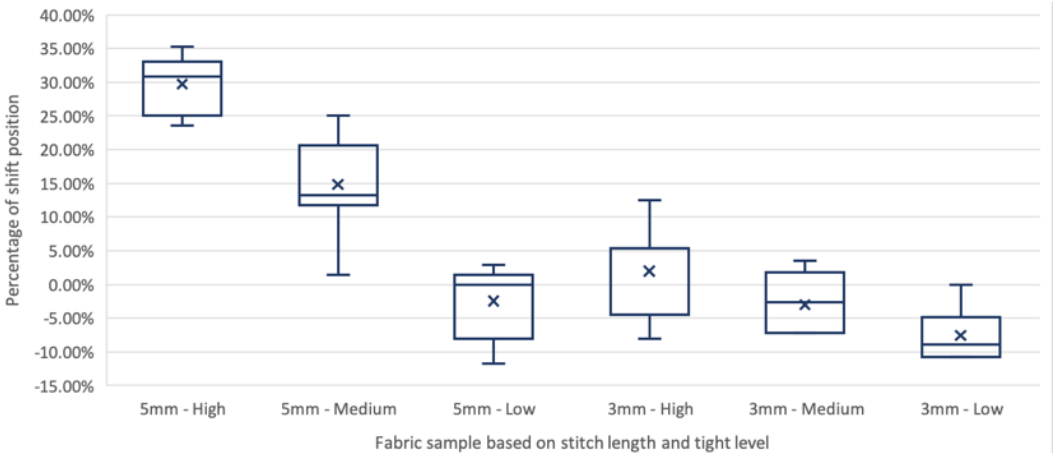


Figure 5.4 Boxplot diagram of shift value of knot position after the dyeing process (in percentage).

The shifted value between the final and initial position can be gathered by measuring the residual sewing thread length. Some numbers showed different shifted value throughout the dyeing process. Six data sets were analysed using a box plot diagram (Figure 5.4). The data were categorised based on the stitch length and the tightness level variables. The analysis did not include the depths of shade variable because it is anticipated that this variable would not affect the mechanical procedure throughout the dyeing process.

The box plot displays an overview of variation data in each category. Each box and whisker plot shows the minimum value, second quartile, median, third quartile, maximum value and average/mean of the shifted position. The zero-per cent on the y-axis of Figure 5.4 shows the initial tightness of each tightness level (Table 5.5) and other values on the y-axis show percentage of the shifted position. The box plot is also useful to present the position whether the data has a positive or negative value. A positive value means that there was an addition to the distance between two knots. With an additional length, the tightness level was looser. On the contrary, the negative value means that the distance between the two knots became smaller, i.e the compression is increased. The box on a graphic shows the interquartile range to measure data spread. There are outliers on the 5 mm stitch length with medium tightness level category and the 3 mm stitch length with high tightness level category.

Table 5.5 Tightness level results before the dyeing process and after the dyeing process.

Stitch length	Tightness level	Initial position	Average shifted value	Average final position
5mm	High	50.0%	(+) 29.7%	79.7%
5mm	Medium	75.0%	(+) 14.9%	89.9%
5mm	Low	100.0%	(-) 2.5%	97.5%
3mm	High	75.0%	(+) 2.0%	77.0%
3mm	Medium	88.0%	(-) 3.0%	85.0%
3mm	Low	100.0%	(-) 7.5%	92.5%

Looking at the value and position of each category, the 3 mm stitch length categories locate not more than 7.5 % on average from the initial position, either with a positive or negative value. This indicates that the knot position on that category was loosened or tighten with no more than 0.8 mm during the dyeing process. An error that less than 10% is still considered as acceptable and consistent because the stitching and knotting process was done manually. Whereas in the 5 mm stitch length categories, the high and medium tightness level showed more than 10% on average above the initial position. This implies that the knot position was significantly looser in both categories. The average final position is presented in Table 5.5. The average final position on 5 mm and 3 mm stitch length specify a relatively similar value within the tightness level category. This is an interesting outcome, given that the initial position for high and medium tightness level was not the same between the 5 mm and 3 mm stitch length. The 3 mm stitch length had a smaller interval because it was not possible to secure the knot on the 50% tightness level. These results suggested that the 50% and 75 % tightness level on the 5 mm stitch length were not stable. Therefore, the most consistent tightness level parameter for stitch-resist dyeing technique is 75% - 88% - 100%.

5.4 Data analysis 1: Objective measurement of the resultant dyeing experiment patterns

The second output from the dyeing experiment was the 54 stitch-resist dyeing fabric samples. Each sample had a different feature depending on

the variables implied. In general, the pattern on fabric samples appeared as white dots in a straight line with three different shades of blue as their backgrounds. The first analysis was an objective measurement conducted using the MATLAB (Matrix Laboratory). The MATLAB is a numerical programming platform using matrix language to analyse data, develop algorithms, and create models and application. This programme has been broadly employed in colour science research, concerning the perception, measurement and communication of colour (Westland et al., 2012). The application of MATLAB in this experiment was to obtain quantitative measurements of pattern value by processing the pattern image. Therefore, a high-quality image was essential in this process. This experiment utilised the DigiEye system by VeriVide to capture the pattern on each fabric sample. DigiEye is a unique, ground-breaking digital imaging system to assess the colour and appearance of textile. It offers complete objectivity, accuracy, consistency and repeatability with four lighting options: CIE D65 with LED Array, CWF, U35, and TL84 (840) (VeriVide, 2019).

5.4.1 Processing pattern image with the DigiEye camera

The image processing setup was conducted across facilities at the School of Design, University of Leeds. In preparation for capturing the image, all samples were steam ironed to flatten and reduce the creases at the Fashion studio. Subsequently, the fabric samples were conditioned in the standard atmosphere (temperature of 20,0 °C and a relative humidity of 65,0 %) for 24 hours prior to the measurement (BSi, 2005). Thereafter, each fabric sample was captured by the DigiEye camera, which placed inside the DigiEye cube at the Colour laboratory.

The image processing was conducted as follows:

1. Switch on the DigiEye cube and wait until the machine is initialised. Click the lighting option for D65 (artificial daylight).
2. Switch on the computer that is connected with the camera and run the DigiEye software.
3. Conduct the camera calibration process by putting the white board on the designated area inside the cube and then capture the image. Replace the white board with the colour chart and then capture another image.

4. Check if the calibration setup is set up with the correct version of the colour chart: version 3.91. The calibration is accepted if the RGB values placed in the range of 210 – 215. Repeat the process if necessary and take out the colour chart from the cube.
5. Place the fabric sample in the middle of the sample stage and capture the image one after another. Save the image in a high-resolution type (TIFF). Turn off the machine and the computer.
6. Crop the images taken with a fixed dimension 760 x 160 mm using computer aided design application to eliminate the DigiEye background and an excess area of the pattern (Figure 5.5).
7. The cropped image then was analysed with the MATLAB programme that records CIELAB values for each pixels.

Figure 5.5 Example of cropped fabric sample image.

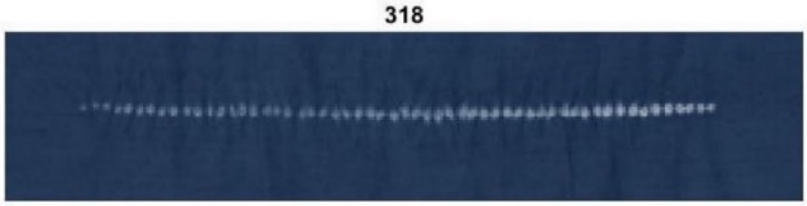
Description: Sample number 318 with specification: 3 mm stitch length – 2 % depth of shade – high tightness level.

5.4.2 Objective measurement with the MATLAB programme

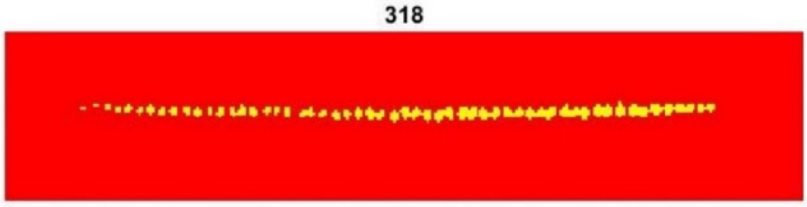
This analysis aimed to provide quantifiers for the stitch-resist dyeing pattern based the colour lightness value. The MATLAB code was constructed to generate three main components: lightness value, number of pixels, and standard deviation (Appendix C1). For the first component, the code was programmed to differentiate colour lightness in two areas, representing the pattern colour which was referred to the white area and the background colour which was referred to the blue area. It then measured lightness value of each and every pixels. The software automatically clustered the pixels as belonging to either the pattern colour or the background colour, and then calculated and presented the minimum, mean, maximum and range value of the white area and blue area. Mean value in the white area reflected the brightness of pattern, whilst the mean value in the blue area presented the

depths of shade. The second component, number of pixels, shows the size of the whole pattern area; the higher the number of white pixels, the larger the white pattern. The number did not show the size of each circles and the spread of the lightness value of each small circle throughout the lines. Figure 5.6b illustrates the segmentation process for an example image where each pixel is automatically classified as belonging to either pattern or background. The yellow area shows the area coverage, but it did not show whether the pattern is blurry or vivid. The third component generated the MATLAB code was a standard deviation of the lightness value on the white area. The standard deviation described the width of data spread from the mean of the white lightness values. Presumably, the higher standard deviation value expresses the blurriness of each circle of the pattern and vice versa. It is however to be noted that since the standard deviation in Lightness value is extracted from measurement of the whole pattern, no information related to the blurriness of individual circle marks in the pattern can be inferred. The code also generated a histogram that represented the distribution numbers of white pixels in correlation to the lightness value (Figure 5.6c). It displayed the position of min, max, mean and mode, so the overall lightness value of each pattern can be interpreted.

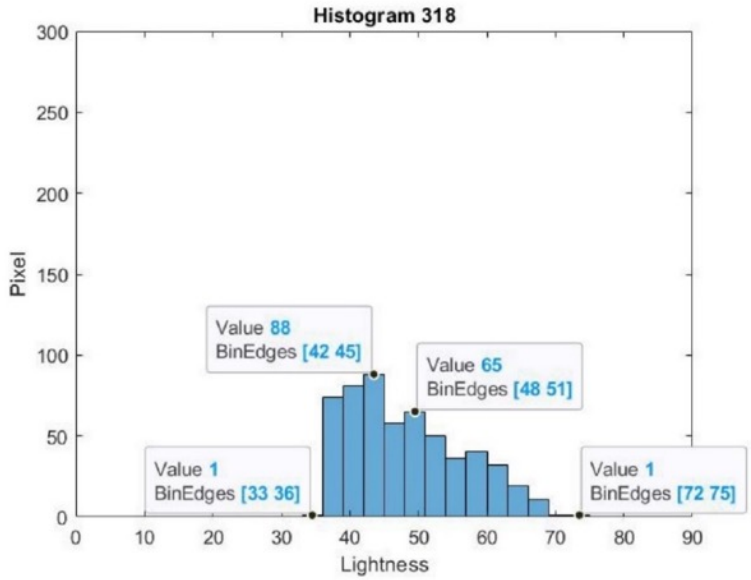
Two hypotheses were constructed from the MATLAB code. The first hypothesis was that the visual perception of the pattern was best described by a power quantity obtained as the product of the number of pixels in white pixels cluster and the mean lightness value of these pixels. This calculation does not represent the individual characteristics of each circle in the overall pattern, nor does it provide information regarding any trends or changes across a single pattern. However, this value represent an average of every circle mark over the entire pattern. The value was used as nominal in statistical analysis to investigate the correlation with other variables. This additional component later termed as pattern quality.



(a)



(b)



(c)

Figure 5.6 Generated image from the MATLAB code.

Description: (a) a typical pattern image; (b) segmentation of each pixel into pattern (shown as yellow) and background (shown as red); (c) histogram of the pattern Lightness values

The second hypothesis was about pattern contrast. Value contrast, or simultaneous contrast, is a concept which explains that perception of colour is affected by the environment in which the hue is placed (Bleicher, 2012:

p.77). Placing a hue on a dark background may make it appears lighter, and it also creates a perception that the lighter hue appears larger (Bleicher, 2012: p.79). Pattern contrast has a strong correlation with visual perception. Therefore, the exploration of the relation between pattern contrast and the independent variables could provide an added insight for discussion. The pattern contrast was calculated by subtracting the mean lightness value of the white pixel cluster and the blue pixel cluster. The pattern contrast implies the degree of contrast from applying the dye at different depths of shade. In summary, five components were generated with MATLAB code:

1. Lightness value,
2. Number of pixels in the white and blue clusters,
3. Standard deviation,
4. Pattern quality, and
5. Pattern contrast.

5.4.3 Results and discussion about the correlation between variables

Simple statistical analysis was used to examine the correlation between the resultant stitch-resist dyeing patterns and the independent variables (stitch length, depths of shade, and tightness level). The quantifier of patterns was represented by the five components generated from the MATLAB programme (see section 5.4.2). In the beginning, the character of the pattern was examined on the circle size by looking at the number of white pixels on the different stitch length category. In average, the size of the entire 3 mm stitch length pattern has $\pm$ 491 white pixels and the entire 5 mm stitch length pattern has a higher number with $\pm$ 648 white pixels. It implies that the entire pattern resulting from the 3 mm stitch length is smaller than that from the 5 mm stitch length. Since there are more needle puncture points for the 3 mm stitch length pattern, this data also indicates that the 3 mm stitch length pattern has smaller circles size. The 3 mm stitch length pattern has 56 circles within the line, thus the average circle area size is of 8.7 pixels; while the 5 mm stitch length pattern has 34 circles within the line, so the average circle area size is of 19 pixels. Thus, size of each circle in the 5 mm stitch length pattern is twice that of the 3 mm stitch length pattern.

The initial analysis was conducted using correlation analysis to determine the relationship between the five dependent variables identified. Pearson’s

standard correlation coefficient r was used to evaluate the strength of the relationships, where $r < 0.3$ represent no association, $0.3 < r < 0.5$ represent a weak association, $0.5 < r < 0.7$ represents a moderate association, and $r > 0.7$ indicate a strong association (note that the sign of the r value indicates whether the correlation is positive or negative). There was a significant negative relationship between the depths of shade applied with the lightness value of the white cluster on average ($r = -0.743$, $p < 0.05$). The correlation coefficient between the depth of shade and lightness value of the white cluster was above 0.7, indicating a strong association. This indicates that as the background colour got darker, the lightness value on pattern colour on average tends to decrease. It implies that the white pattern colour became less white or bluish in the darker shades of background, which is in line with the character of the stitch-resist dyeing, that includes blurred edges. Interestingly, there was also a significant positive relationship between the lightness value of the white and the blue clusters ($r = -0.770$, $p<0.05$), which support the previous correlation (Figure 5.7).

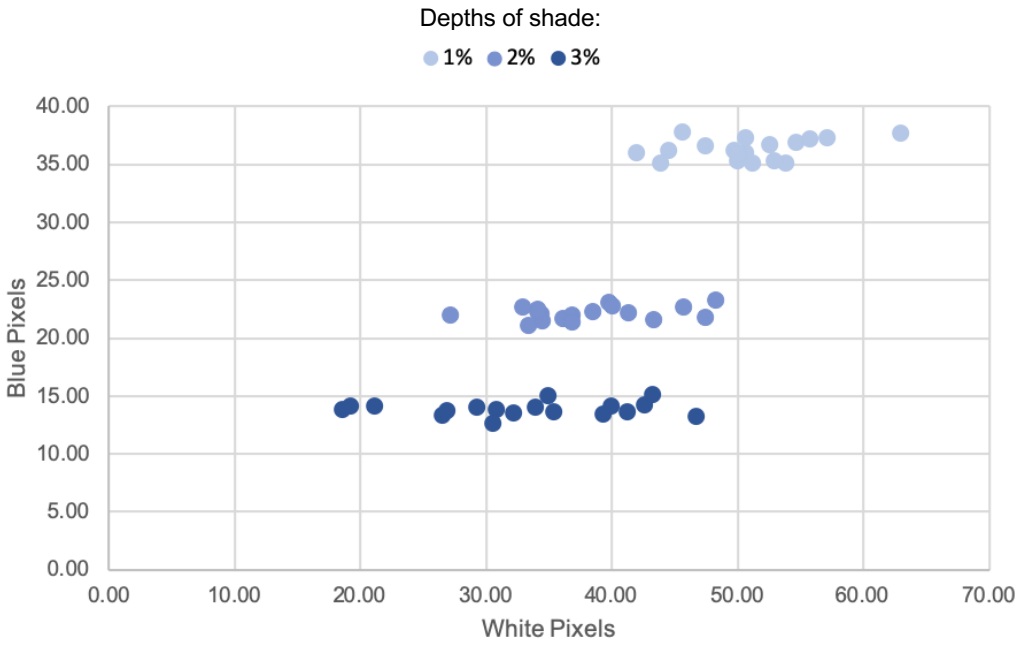


Figure 5.7 Correlation between the lightness values of the white pixels and blue pixels (mean).

5.4.3.1 Pattern quality

This section examines the first hypothesis about pattern quality and their correlation with the three independent variables: depths of shade, stitch

length and tightness level. Pattern quality was a unit that represents the pattern size (number of pixels) and pattern mean lightness value (mean L* value of white pixel cluster). Therefore, a higher value in pattern quality can indicate a larger size or a lighter pattern or a combination of both.

Correlation analysis was conducted between the pattern quality and each of the three variables: depths of shade, stitch length and tightness level. The result showed that only depths of shade has a significant negative relationship with the pattern quality ($r = - 0.715$, $p < 0.05$). The correlation coefficient indicates a strong association which is similar to previous findings: the mean of white lightness value tends to decrease in a darker background colour. The other two variables, stitch length and tightness level, show no correlation, with the correlation coefficients being ($r = 0.157$, $p < 0.05$) and ($r = -0.210$, $p < 0.05$) for the stitch length and tightness level respectively.

A multiple regression analysis was carried out to investigate the nature of the relationship between all three variables and the pattern quality. The objective of regression is to define an expression (or model) of the relationship between variables, which enables predictions about one variable performance, based on other variables (Flemming and Nellis, 2000). The prediction models showed strong Pearson's correlation coefficient ($r = 0.788$, $p < 0.05$). The results of the regression also indicated that the model explained 62% of the variance and the model was a significant predictor of the pattern quality results, $F(3,50) = 27.386$, $p = 0.000$. Interestingly, all three variables contributed significantly to the model with the depths of shade having the highest contribution ($b = - 10054.8$, $p = 0.000$), followed by the tightness level ($b = - 379.9$, $p = 0.001$), and the stitch length ($b = 2583.7$, $p = 0.013$). In addition, these B values give an idea of the effect of each predictor has on the outcome if the effects of the other variables are held constant. For example, (1) depths of shade ($b = -10054.8$): as depths of shade decreases by one unit (i.e. by one percent), the pattern quality value increases by 10054.8 units; (2) tightness level ($b = - 379.9$): the pattern quality value increases by 379.9 units if the tightness level decreases by one unit (i.e. by one percent); (3) stitch length ($b = 2583.7$): as stitch length increases by one unit (i.e. by one millimetre), the pattern quality value increases by 2583.7 units. So, the final prediction model was: Pattern quality = 66330.2 – (10054.8 * depth of shade) – (379.9 * tightness level) + (2583.7 * stitch length).

A bar chart was generated to display the average of pattern quality between 3 mm stitch length and 5 mm stitch length within three tightness level and three levels of shade (Figure 5.8). The majority of the data shows that the 5 mm stitch length pattern has higher pattern quality compare to the 3 mm stitch length, except one category, which is the 1% depth of shade in high tightness level. In general, the bar chart shows a similar pattern with Figure 5.7, the group of patterns with lighter shade has a higher pattern quality value on average, and this value decreases gradually as the depth of shade increases. The pattern quality in the 2% omf depth of shade category is approximately half of the only pattern quality in the 1% omf depth of shade category. Whereas the decrease in pattern quality between the 2% omf depth and 3% omf depth of shade category is no more than 20%.

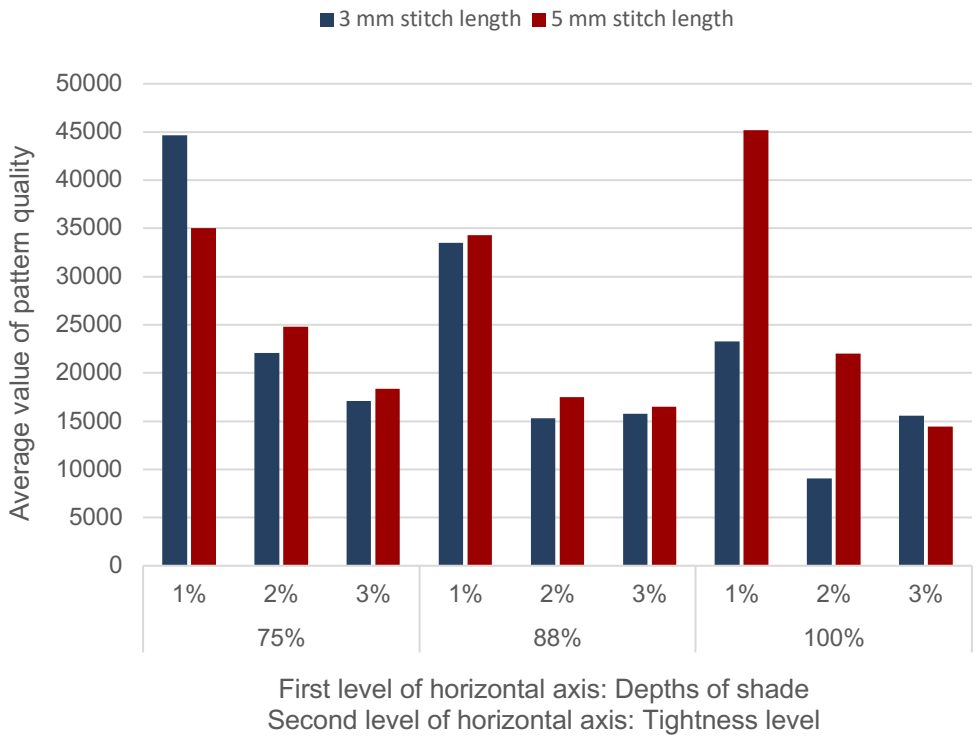


Figure 5.8 The correlation between pattern quality and the three variables: stitch length, depths of shade and tightness level.

5.4.3.2 Pattern contrast

This section investigates the second hypothesis about pattern contrast in terms of its relationship to the three variables: depth of shade, stitch length and tightness level. The value from pattern contrast was generated by

subtracting the mean lightness value of the white cluster to the mean lightness value of the blue cluster. The contrast value difference between the pattern and the background represent the visibility and perception of the pattern (Bleicher, 2012). The higher white value does not guaranteed a good pattern clarity because of the different background lightness value. The investigation also attempts to see if there is a connection between pattern contrast and pattern quality.

Similar analysis method as for the pattern quality was conducted to examine the correlation of the pattern contrast to all three dependent variables. The result showed only tightness level (in percentage) has a significant negative relationship with the pattern contrast ($r = -0.731$, $p < 0.05$). The correlation coefficient indicating a strong negative association, while the other two variables showed no correlation, stitch length ($r = -0.247$, $p > 0.05$) and depth of shade ($r = 0.283$, $p > 0.05$). It indicates that the pattern contrast tends to increase if the tightness level decreases, i.e. if the compression increased.

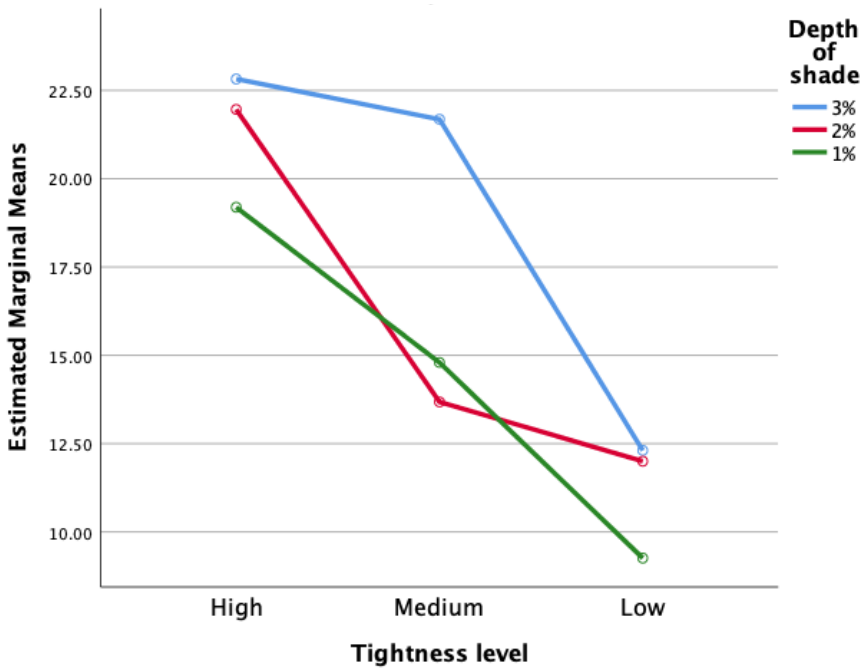


Figure 5.9 The correlation of tightness level and depth of shade with the marginal means of pattern contrast.

The second investigation of the relation between the pattern contrast and all three variables was conducted with a multiple regression analysis. The prediction models showed strong Pearson's correlation coefficient ($r = 0.776$, $p < 0.05$). The results of the regression also indicated that the model explained 60% of the variance and the model was a significant predictor of the pattern contrast results, $F(3,50) = 25.226$, $p = 0.000$. From all three variables, tightness level ($b = -0.511$, $p= 0.000$) and depths of shade ($b = 1.984$, $p= 0.008$) contributed significantly to the model, and the stitch length did not ($b = -0.516$, $p= 0.393$). As the tightness level decreases by one unit (i.e. by one per cent), the pattern contrast increases by 0.511 units; the pattern contrast increases by 1.984 units if the depth of shade increases by one unit (i.e. by one per cent). Thus, the final prediction model was: Pattern contrast = 58.849 – (0.511 * tightness level) + (1.984 * depth of shade).

Figure 5.9 shows the relationship between tightness level and depths of shade to the mean pattern contrast. Overall, the graphic shows when both tightness level and depths of shade in the highest value, the pattern contrast tend to have the highest value among that shade level. The darkest shade (3% depth of shade) has the highest average pattern contrast in all tightness levels. The average pattern contrast in the 2% depth of the shade is mostly higher than the 1% one in all tightness level besides on the medium tightness level. Both 1% and 2% depths of shade patterns have almost similar average pattern contrast at the medium tightness level. This result was related to the fact that there was a great shift in the medium tightness level output as it shown in Figure 5.4. Nonetheless, the data still suggests that the combination of a darker shade and higher compression from the knotted threads produces an intense pattern contrast, which agrees with the contrast value theory published in the literature (Bleicher, 2012).

5.5 Data analysis 2: Visual perception study of the resultant dyeing experiment patterns

This section described the second data analysis on the fabric samples based on the visual perception using purposive participants. Combining two different methods was an attempt of triangulation analysis in order to get a deeper understanding of the correlation from the objective value and human perception value. The study examined two values which were the pattern clarity and pattern preference. Pattern clarity was the value that defined how

well the pattern could be perceived by the participants. The pattern preference was analysed to understand participants' preference towards the stitch-resist dyeing samples and the reasons behind this preference.

5.5.1 Experiment setup and method

The experiment was set up at The Colour Laboratory, the School of Design, University of Leeds. Every examination was conducted under a light box with a light setting on D65, the artificial daylight. Participants were positioned facing the centre of the lightbox with a distance of 80 cm from the light box back wall to their shoulder point (Figure 5.10). Participants were asked to remain relatively still in that position, with the same angle towards the samples, to keep the consistency of data collection method.

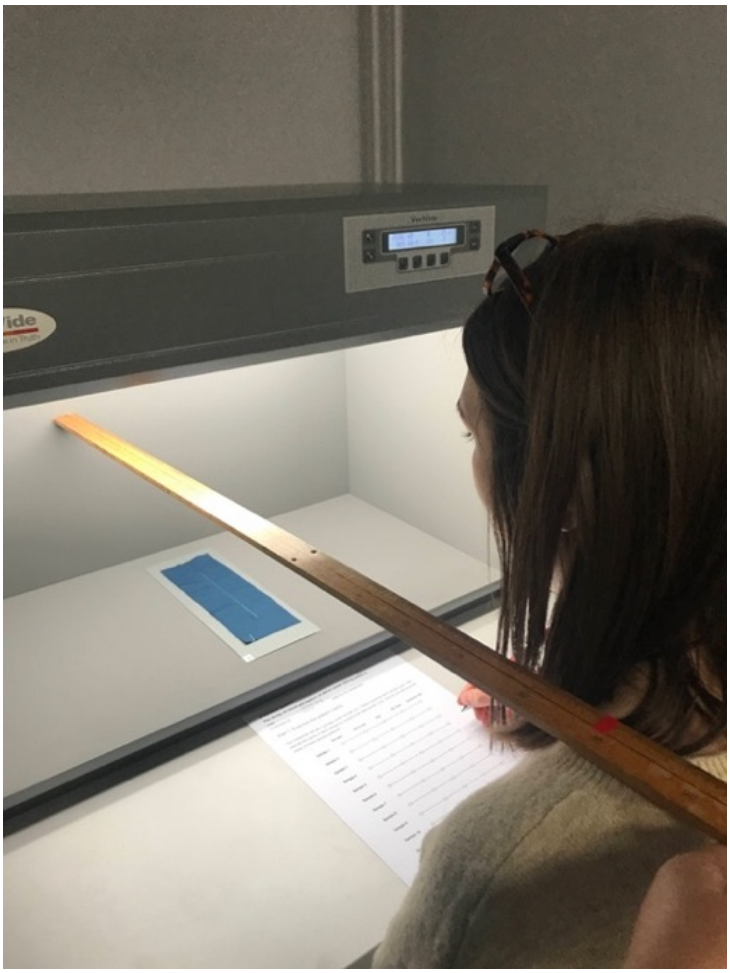


Figure 5.10 Experiment setup for the visual perception study part 1.

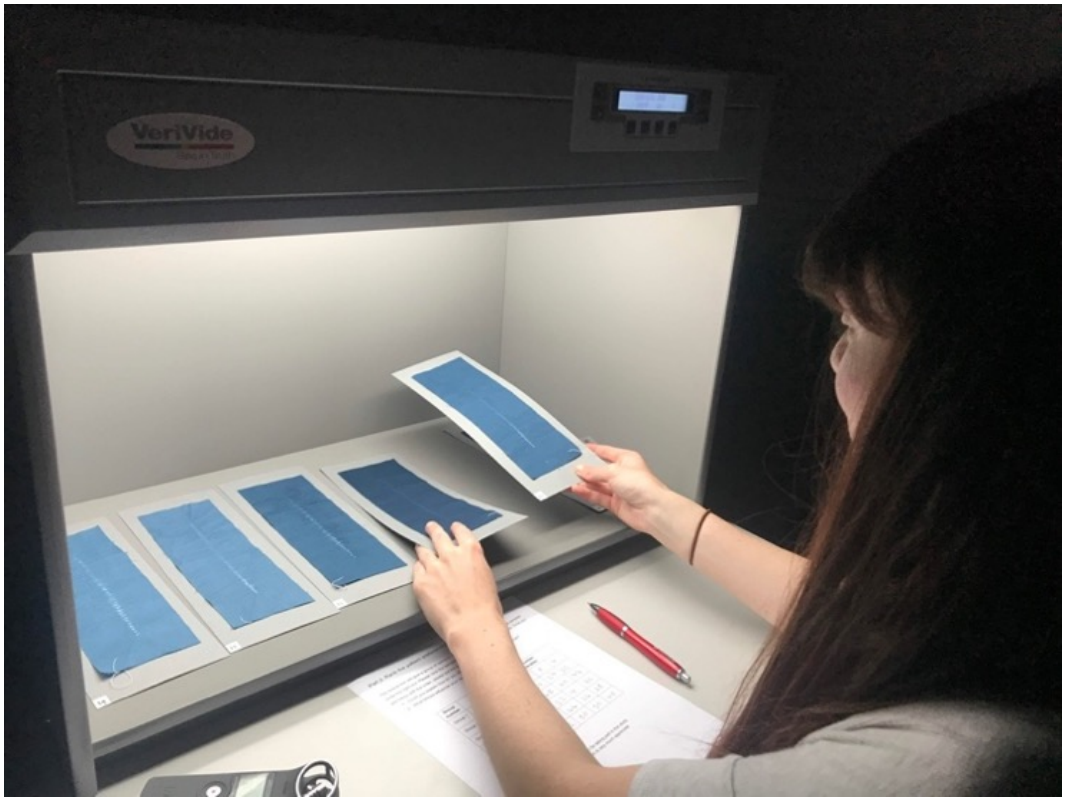


Figure 5.11 Process of resolving the preference order on the second part of visual perception study.

This study had two parts, and it was designed based on the MATLAB values. The 54 fabric samples were shuffled randomly and attached to the top of a thick grey paper as a neutral colour. The paper functioned to move the fabric sample more easily and labelling with a number for the participants' benefit. The first part of the experiment examined the pattern clarity using a 5 points Likert scale. The scale was (1) not clear, (2) fairly clear, (3) clear, (4) very clear, and (5) extremely clear. Once the participants had examined and rated all fabric samples, the session was followed by an interview to define the pattern clarity.

The second part of this study was to examine people's preference for the stitch-resist dyeing pattern. This part used a ranking method from less preferable on the left hand side to most preferable on the right hand side. One sample was randomly selected from each combination of the three variables: stitch length, depths of shade and tightness level, and six groups were created with six samples on each group (see Table D1, Appendix D5). Group one until three were categorised based on the level of shade (1% - 2% - 3%), and group four until six were grouped based on the tightness level

(high – medium – low). Those thirty-six samples were labelled with even number only in order to facilitate the process of reforming the groups during the experiment since those samples were also included during the first part. The participants were able to move around the six samples in each group to help them decided the appropriate visual order (Figure 5.11). Once the order had been confirmed, the participants were asked the reasons behind the selection. The details of the research process for this study are described in Table 5.6.

Table 5.6 Description of research method for the visual perception study.

No	Procedure	Time	Quantitative	Qualitative	Purpose	Tools
1	Gave an introduction and asked the participants to fill the consent form	3 min	N/A	N/A	To explain the research background and collect the consent form	Paper and pen
2	Asked for participants to fill the participant's profile sheet	3 min	Demographic data and knowledge base about the technique	N/A	To understand the participants' background and prior knowledge of the stitch-resist dyeing technique	Paper and pen
3	The first part: Assessing the clarity of pattern					
	Provided a brief explanation about the stitch-resit dyeing technique and pattern example	6 min	N/A	N/A	To explain the technique as to provide the participants with sufficient knowledge to make informed judgements regarding pattern clarity.	Laptop and Video
	Set up the participant's position towards the sample	5 min	N/A	N/A	To obtain a consistency position with a similar	Ruler stick

No	Procedure	Time	Quantitative	Qualitative	Purpose	Tools
	(Figure 13) and turned off the room lights.				viewpoint of each participant	
	Set a sample under the light box, in the middle position	20 - 30 min	How do you perceive the clarity of these sample patterns in scale 1-5? 1= not clear, 2 = fairly clear, 3 = clear, 4 = very clear, 5 = extremely clear	How do you define the pattern clarity? What factors that you consider when examining the pattern clarity?	To obtain an understanding of the clarity of stitch-resist dyeing pattern from human perception.	Light box, fabric samples mounted on thick neutral grey paper, answer sheet paper with the Likert scale, pen, and tape recorder
	Participants examined each sample given, then indicate the clarity scale of each sample by crossing the appropriate circle on the Likert scale after all samples are examined. Asked about the definition and factors of the pattern clarity.					
4	The second part: Assessing participants' preference for fabric samples					
	Provided a brief explanation on how to answer this part	3 min	N/A	N/A	To explain the procedure of part 2 with the ranking system	Answer sheet and pen
	Put a group of 6 samples under the lightbox	20 - 30 min	Please rank the six samples from less preferable to most preferable.	How do you decide the order based on your preference? What factors influence your decision?	Evaluation of participants' pattern preferences of stitch-resist dyeing patterns with different influential factors	fabric samples mounted on thick neutral grey paper, answer sheet paper, pen, and tape recorder
	Asked participant to examine the samples under the light box, then rank the samples from less preferable on their left side to most preferable on their right side.					
	Asked participants to					

No	Procedure	Time	Quantitative	Qualitative	Purpose	Tools
	put the order on the answer sheet and then asked their preferences. Repeat these steps for all 6 groups.					

5.5.2 Experiment participants

The purpose of this data analysis was to determine the perception of stitch-resist dyeing pattern from different people. Therefore, this study employed a purposive sampling method, known as non-probability sampling. The aim of applying purposive sampling in this study was to focus on a specific population who has the expertise to answer the research questions (expert sampling). There are two characteristics for the purposive sampling: (1) a person has a design background, specifically textile or fashion design; (2) a person has a cultural relationship with the stitch-resist dyeing cloth. The selected participants for this study were required to meet at least one criterion or both. People with design background had the ability to describe a visual image with design terminology even without being familiar with the technique. Whilst, participants who have a relation with the cloth were able to define the pattern based on the existent cloths.

The participants profiles are described in Table E.1, Appendix E1. In total, 20 participants met the criteria of design background or cultural background or both. Eight participants (40%) had design background without cultural relation; six participants (30%) had a design background and cultural relation, and the last 6 participants (30%) had cultural relation without a design background. The ratio of gender on the purposive sampling was 85% female and 15% male, with 18 of 20 participants are a combination of postgraduate and undergraduate students. Half of participants were 20-29 years old, and the other half were 30-39 years old. All participants had a fair knowledge of the stitch-resist dyeing technique and slightly better knowledge about tie-dye and *batik* (see Table E.1).

5.5.3 Results and discussion from the visual perception study

The results and discussion from this study are presented in two parts: visual perception of stitch-resist dyeing pattern clarity and participants' preference of stitch-resist dyeing pattern. Each part has different objectives and approaches. The result and discussion includes the quantitative data as well as the qualitative data from each part.

5.5.3.1 Visual perception of the stitch-resist dyeing pattern clarity

Data gathered from the Likert scale was translated and calculated as 1 point for the 'not clear' scale point until 5 points for the 'extremely clear' scale point. By calculating the average score from all participants, the perception of clarity was generated from each fabric sample. This was later termed as the clarity value.

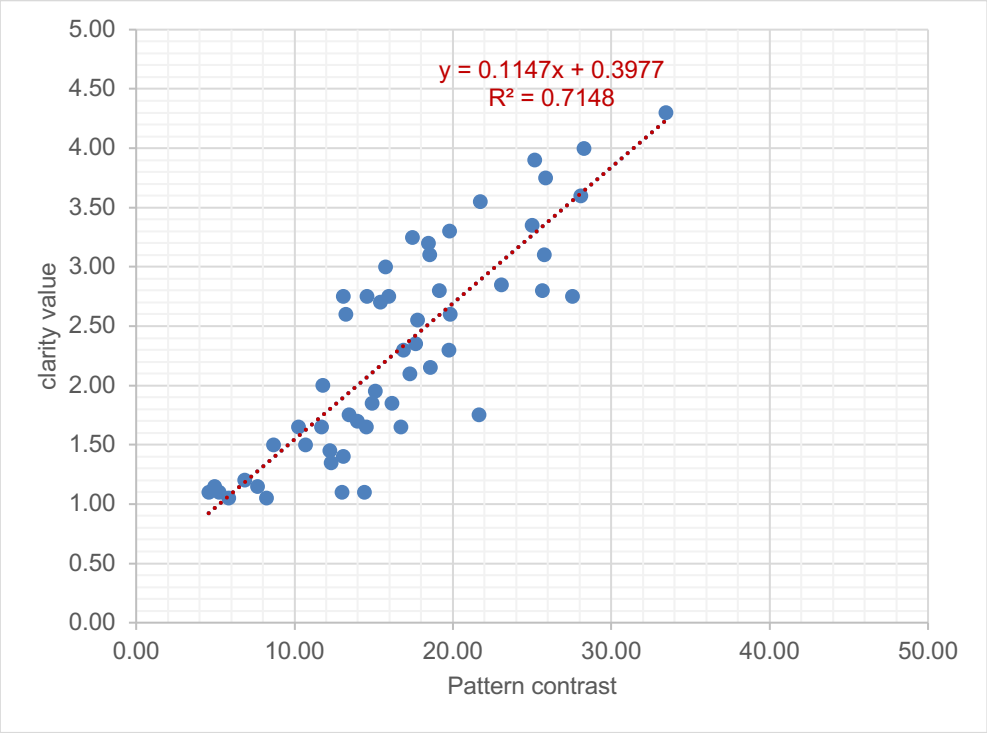


Figure 5.12 Correlation of visual perception between clarity value and pattern contrast.

The relationship between clarity value with the pattern quality and pattern contrast extracted from the MATLAB code, then was examined using

correlation analysis. The result showed that there was no correlation between clarity value with the pattern quality ($r = 0.239$, $p > 0.05$). On the contrary, there was a significant correlation between clarity value with the pattern contrast ($r = 0.845$, $p < 0.05$). The correlation coefficient was indicating a strong positive association which indicates that the clarity value tended to increase if the pattern contrast increases (Figure 5.12). It could be translated that participants tend to perceive the pattern sample clearer if the sample had a higher pattern contrast between the motif and the background colour. The clarity value also showed a strong negative association with one independent variable, tightness level ($r = - 0.765$, $p < 0.05$). This result was consistent with the outcome that the tightness level had the highest significant predictive value in relation with pattern contrast (see section 5.4.3.2)

The statistical analysis showed that the pattern contrast was the only component that influences a participant's perception of stitch-resist dyeing pattern clarity. The interview transcriptions provided more understanding of participants' perception. In terms of defining pattern clarity, several keywords were mentioned by the majority of participants: contrast, consistency, and character of pattern. A sample of transcription from this study is provided in Appendix E2. The contrast was defined by the majority of participants as the difference between pattern colour and background colour. They perceived the pattern much better on the darker background colour. The evenness of background colour was also one of component that participants considered in terms of clarity. The blotchy visual mostly appeared on the lighter shade. The stitch-resist dyeing process created creases which retained some area from dyestuff, but creases also caused some area to have more dyestuff than others, leading to unlevelness.

The discussion about clarity value was also related to the second keyword, consistency. Consistency was described as a pattern regularity throughout the stitching line. Some patterns showed less existence of one half part of the stitching line; the line appeared to be faded or disappeared. By fading or disappearing, it implies that the pattern was not consistent in terms of lightness and size of each circle. This effect occurred mostly on the pattern sample that had a low or medium tightness level. Although some of the participants indicated the fading as an unclear pattern or faulty, some participants considered it as a handcrafted signature. The discussion of consistency also covered about the distance or gap between each circle.

Different space between the circles was constructed when the circle became wider, so it left smaller space between the circles, even occasionally the circles looked like they collided. This appearance usually occurred in the centre part of the line, mostly in the 3 mm stitch length pattern. The participants perceived the sparser area as an indication of a clearer pattern because each individual dot appeared evidently.

The last keywords were about the pattern character. The character that was defined for the pattern clarity are shape, size and also blurriness of each circle. Some participants perceived that each circle appeared differently within the line in one pattern sample or with another pattern sample. They considered a larger circle with less blurry effect on the edge as a clearer pattern. Some circles also occurred more likely as an ellipse shape than a circle. The circle seemed to be skewed throughout the pulling process. This character occurred only on the 3 mm stitch length pattern where the line has a greater number of small circles with a smaller distance between them.

5.5.3.2 Participants' preference for stitch-resist dyeing pattern

The main objective for conducting this part of this experiment was to examine people's preference towards the stitch-resist dyeing patterns. Examining the preference can help to understand the toleration level of acceptable pattern from the user viewpoint towards the stitch-resist dyeing patterns. The rank from each group was translated into a six points scale with one point allocated the 'less preferable' sample and six points to the 'most preferable' sample. Then, an average of the point from all participants was calculated to generate the pattern preference scale of each fabric sample. Correlation analysis was conducted towards each group to examine the relationship between factors that influenced the pattern preference scale. Three factors were analysed, and the results are described in Table 5.7. The discussion of this section was constructed within two categories. The first category was groups based on the depths of shade which includes group 1, group 2, and group 3. The second category was groups based on the tightness level, which include group 4, group 5, and group 6.

The correlation analysis results in Table 5.7 describe that most of the correlation coefficients of the first category groups (depths of shade) show strong associations between pattern preference with the clarity value and pattern contrast ($R > 0.910$, $p < 0.05$). It implies that when there was no

colour variation within the group, participants tend to rank their samples based on clarity. There was a strong association between pattern preference and pattern quality in group 1 (R = 0.788) and group 2 (R = 0.907). However, in overall groups, the relationship between pattern preferences and pattern quality is less strong than the relationship with the clarity value and pattern contrast.

Table 5.7 Correlation coefficient between pattern preference and the influence factors.

Group number	Pattern preference x Clarity value	Pattern preference x Pattern contrast	Pattern preference x Pattern quality
	R	R	R
Group 1	0.918	0.972	0.788
Group 2	0.965	0.930	0.907
Group 3	0.954	0.917	0.618
Group 4	0.878	0.736	0.387
Group 5	0.880	0.703	0.113
Group 6	0.971	0.733	-0.017

The investigation was followed by producing bar charts showing the relation between pattern preference with pattern contrast for each group (Figure 5.13, Figure 5.14, and Figure 5.15). The bar charts display the rank value on average within each group. The y-axis plotted the contrast value of each pattern sample, and the x-axis was generated based on the average pattern preference scale from less preferable to most preferable. The x-axis also displays an identity of each fabric sample: sample number, tightness level, and stitch length. In general, the bar charts for group 1, group 2, and group 3 display a similar concept with the correlation coefficient analysis.

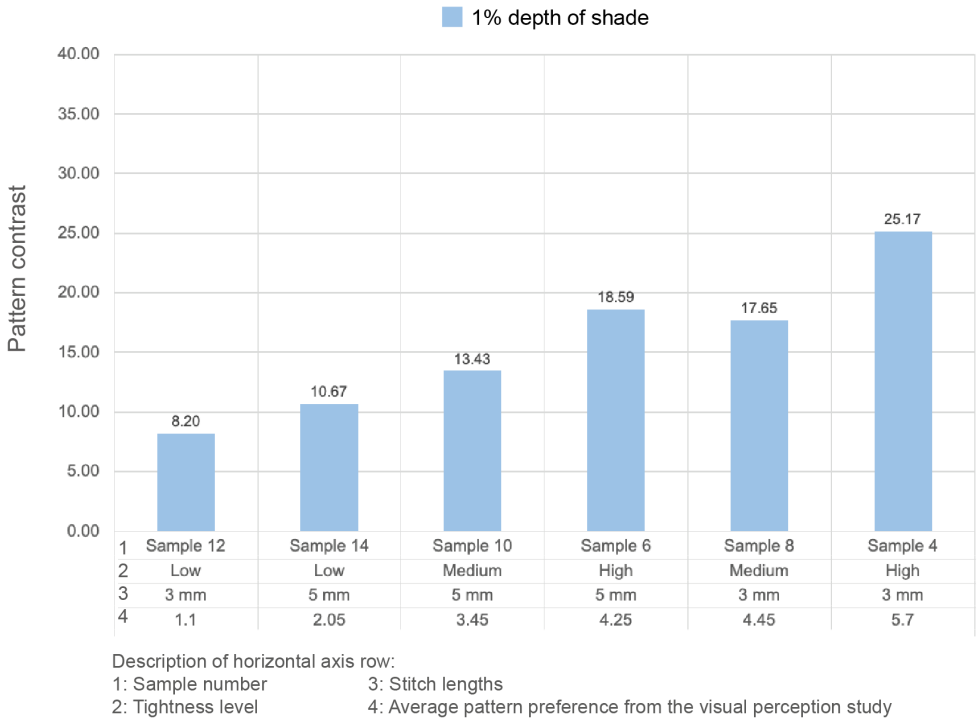


Figure 5.13 Pattern preference of the stitch-resist dyeing samples in group 1: 1% depth of shade.

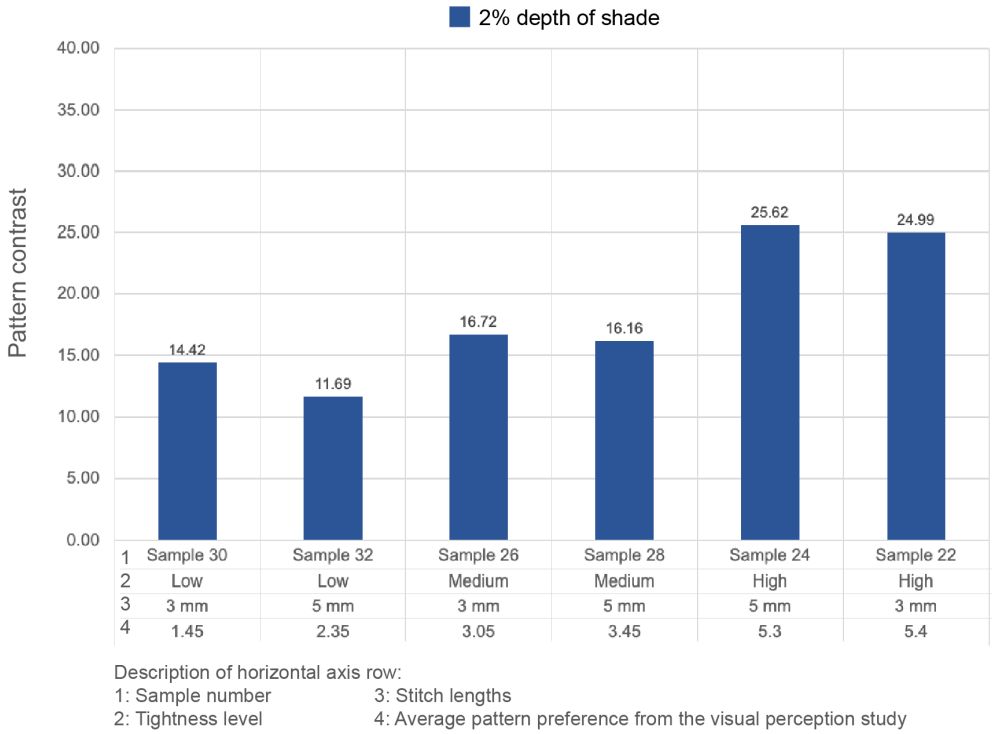


Figure 5.14 Pattern preference of the stitch-resist dyeing samples in group 2: 2% depth of shade.

The pattern contrast took an important role in deciding the order. Although in some orders, the pattern contrast was not the determining factor. Based on the interview, personal preference about size also influenced the decision in this group category. Some participants preferred a large pattern because it was clear, but some others preferred a small pattern because it represented a high level of craftsmanship and more effort. Fading out effect within in line was also considered as a unique effect for some participants because it reminded them of an ombre effect, where the other thought it was faulty. The opinion about irregular shape was also split between participants who reflected it as a “happy accident” and participants who considered it as a flaw.

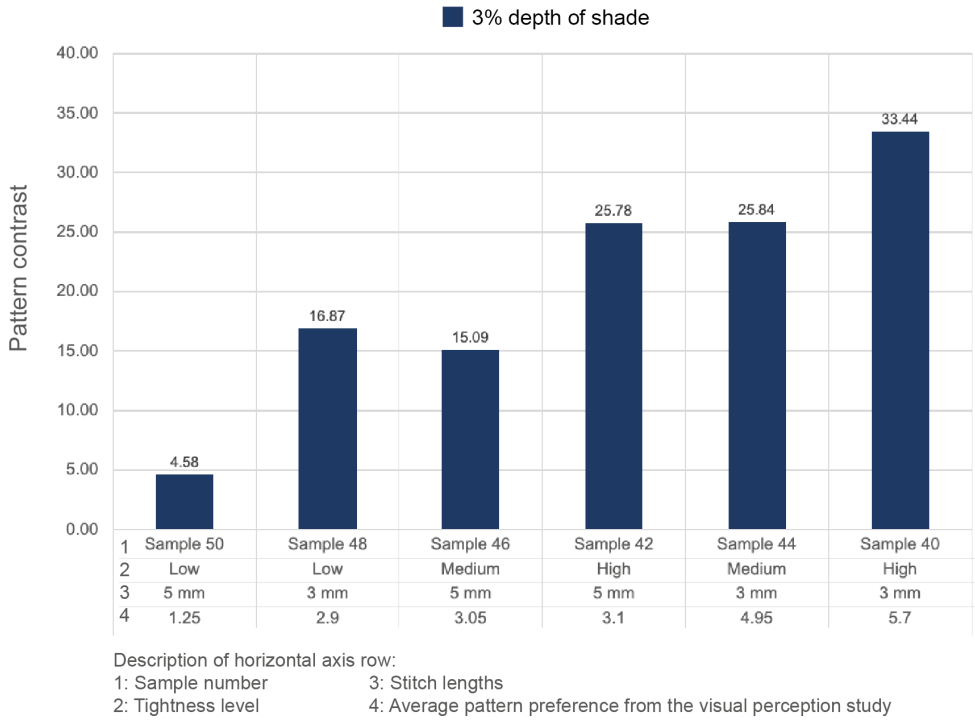


Figure 5.15 Pattern preference of the stitch-resist dyeing samples in group 3: 3% depth of shade.

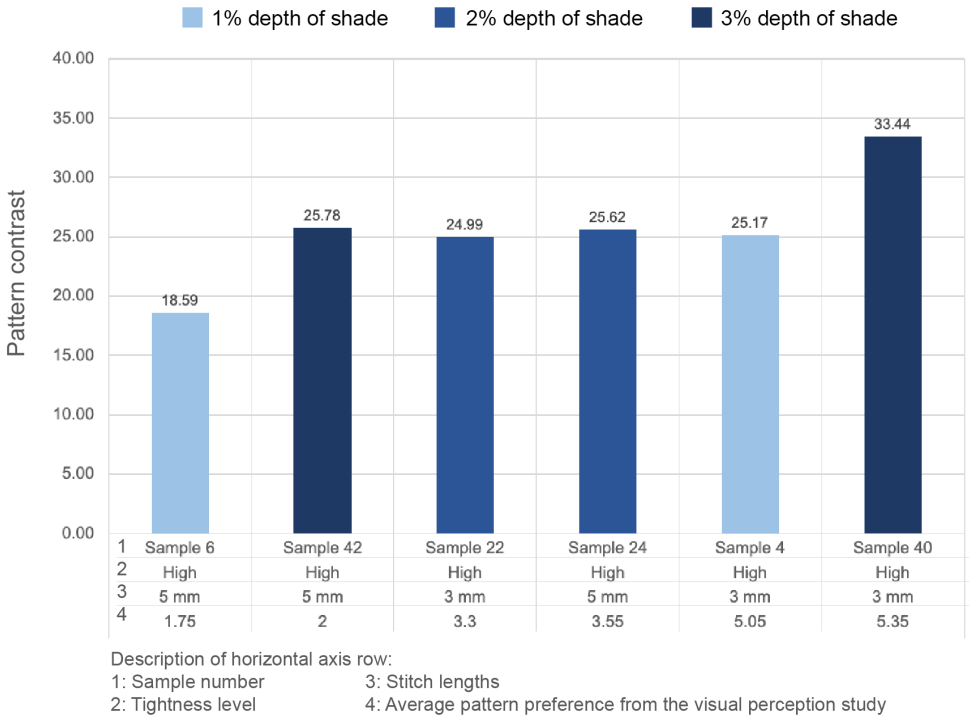


Figure 5.16 Pattern preference of the stitch-resist dyeing samples in group 4: high tightness level.

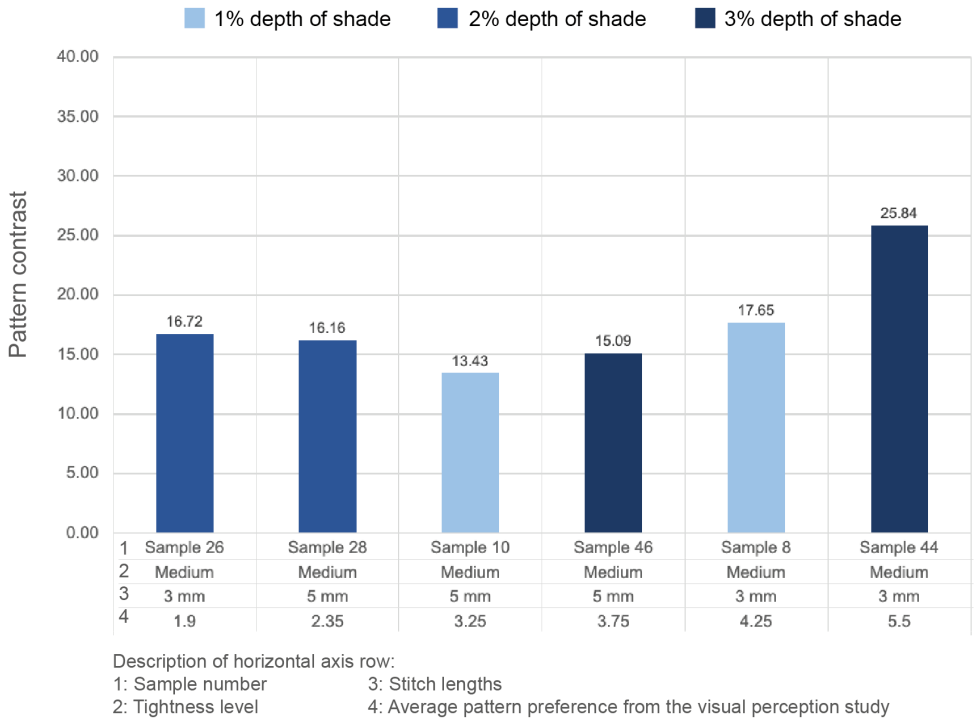


Figure 5.17 Pattern preference of the stitch-resist dyeing samples in group 5: medium tightness level.

The second group category (group 4 - 6) was based on the tightness level, which means that there was a variation of depths of shade within each group (Figure 5.16, Figure 5.17, and Figure 5.18). The correlation coefficient between pattern preference and clarity value in this category showed an increase from group 4 (high tightness level) to group 6 (low tightness level) (Table 5.7). It implies that the clarity value had a greater influence when the pattern displayed less contrast. Many participants mentioned that they found it hard to decide the rank in group 5 and group 6, especially group 6 because they could hardly distinguish the pattern. Thus, their decision was only based on the most visible within the group.

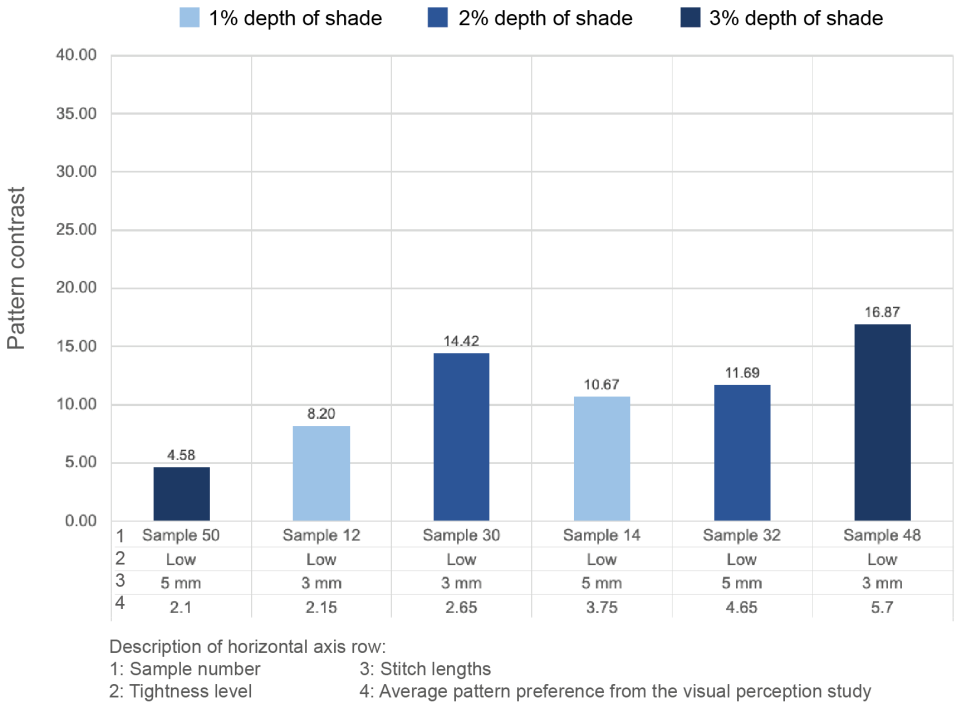


Figure 5.18 Pattern preference of the stitch-resist dyeing samples in group 6: low tightness level.

Group 4 is a good sample of group for this category because it had a high tightness level samples with three different shades. The clarity in this group was high, so the preference was not entirely influenced based on clarity value. Similarly, personal preferences that were discussed in the first group category also applied in this group. However, most of the participants were conflicted when deciding their choice between sample number 4 and sample

number 40. Sample 4 represented a sample with high pattern quality (large pattern size) but low contrast value (1% depth of shade). On the other hand, number 40 had a high contrast value (3% depth of shade) but low pattern quality because it has a small pattern size. So, both patterns show a similar clarity. In the end, sample 40 became the most preferable among the participants because it had better contrast, more consistent space between circles throughout the line, and reflected good craftsmanship skills. Participants thought that the consistent skewed circle shapes throughout the line indicated a good handmade pattern. Small space between circles on sample number 4 made the circles collided and appeared to be a regular line; not a line consisted of small dots. It lost the signature of stitch-resist dyeing pattern.

5.6 Summary

This chapter presents an extensive study of the correlations between Indonesian stitch-resist dyeing key factors and their effects on resultant patterns. By understanding the correlation, this experiment was attained to find a solution for the Indonesian stitch-resist dyeing production issue. One of the methods conducted in this chapter was a procedure for applying parameters of the tightness level for the experiment (see section 5.1.2). This method can be used to solve the pattern inconsistency issue faced by the Indonesian craft makers. The nominated length for recommended tightness level can be measured with the equation: nominated length = tightness level x ((pattern length/ stitch length) + 1 x fabric thickness). The measurement can be done precisely or on average. The fabric thickness should be considered with the stitch length; larger stitch length should be applied in a thicker fabric (Titisari, 2012). It implies that by applying larger stitch length, the number of pleats in the fabrics becomes smaller. For example, if the craft maker wanted to create small dots (3 mm stitch length) in a 75 cm length pattern in cotton fabric, which has average fabric thickness 0.2 mm, the craft maker needs to make sure that the knot position is in 75% tightness level to get the most visible pattern. The calculation is: 75% x ((750mm / 3mm) + 1) x 0.2mm = 50mm or 5 cm. It means the fabric should be gathered up to 5 cm assuring the compression level is tight enough to produce a clear pattern.

The results from this experiment suggest that there is a correlation between three variables, stitch length, depths of shade and tightness level, with the

resultant pattern. The resultant pattern was measured by the pattern quality and the pattern contrast for the first data analysis, and by the clarity value and the pattern preference for the second data analysis. Visual perception towards imperfections was investigated through the laboratory experiments from people with a design background and non-design background with cultural heritage related to the technique (section 5.5.3.2).

In result, from the three variables, the tightness level plays a significant factor in resulting in a clear and preferable pattern. High tightness level produces a high pattern contrast, which perceived by the majority of the participants as a good clarity. Pattern with high tightness level also creates a more consistent pattern in terms of size and space, which was perceived by some of the respondents as a good craftsmanship skill. The depths of shade is also considered as an important point in creating a contrast value; while the stitch length can determine the character of stitch-resist dyeing pattern. The respondents defined the pattern character from the shape, size and also blurriness of each little circle of stitch-resist dyeing pattern. The respondents' opinions were divided into two categories. Some participants refer a larger circle with less blurry effect on the edge as a clearer pattern, and other participants refer the small circles as an intricate pattern. Although, they are agreed that both type of patterns should be consistent throughout the line.

The results illustrate the acceptance level of the pattern by participants. Overall, some irregularity in the patterns were considered as a "happy accident" if they appear in repetition, and as a defect, if it is only a singular feature. The study also demonstrated that the level of tightness between the two knots was the important factor to create a regular pattern. It implies that the resist mechanism plays an important part in ensuring the consistency of the pattern. Therefore, this particular point was the main consideration in constructing the revitalisation strategies. The next chapter discusses the appropriate revitalisation strategies based on findings from this laboratory experiment and the survey (chapter 4).

Chapter 6
Appropriate technology and organisation as revitalisation strategies for the Indonesian stitch-resist dyeing practices

The objective of this chapter is to describe appropriate revitalisation strategies for the Indonesian stitch-resist dyeing practices based on findings from the case studies (chapter 4) and the findings from the laboratory experiments (chapter 5). This chapter is structured as follow: firstly, explaining the creative ecology of Indonesian stitch-resist dyeing, which the fundamental points are compiled from the survey findings and the experiment results (section 6.1). Secondly, the existing revitalisation strategies in the Indonesian stitch-resist dyeing are examined in section 6.2. Then the discussion is followed by suggested revitalisation strategy for the Indonesian stitch-resist dyeing practices, which consists of a recommendation of applying appropriate technology and organisation for the community (section 6.3). Section 6.4 explains the implementation scheme for the suggested revitalisation strategies in a holistic view. The last section (6.5) presents a summary of this chapter.

6.1 The situation and issues of the Indonesian stitch-resist dyeing practices after commercialisation

From the survey results, the stitch-resist dyeing practices were considered to have strong cultural related in each survey location in Indonesia. The craft makers in each location has utilised the technique to produce artefacts based on their social, historical, and aesthetic values. The globalisation and commercialisation have impacted on Indonesian stitch-resist dyeing with a ripple effect. This section aims to examine the impacts that were referred by the survey participants (see section 4.6). The discussion explores the possible causes on issues about the improvement of pattern quality and the craft makers welfare, related to the survey findings and experiment results. The analysis begins with exploring the creative ecology of the stitch-resist dyeing craft practice in each location, and how they overcome the globalisation and commercialisation effects. The definition of creative ecology has been described in section 1.2.3, thus this section explores the

interrelated relationships between the intrinsic factors on this practice, i.e. priorities, perceptions, motivations, values, responsibilities of the craft makers, and the extrinsic factors, i.e. the Indonesian governments, associated organisations or communities and resources.

The beginning of most stitch-resist dyeing craft industries that exists in Indonesia was initiated by a small community, and then it flourished with significant support from the Indonesian government. However, the starting point of the stitch-resist dyeing craft industry in Palembang was an exception, where the existing practices were not initiated by the current craft makers, but they continue the tradition of manufacturing goods from the preceding generations. Although, the Indonesian government still plays a significant role to support the continuation and expansion of the craft industry in Palembang. The expansion of stitch-resist dyeing has transformed the initial practice to become a community enterprise in each survey location. A community enterprise is defined as:

> *"A group of neighbours in one or more villages in the same sub-district or beyond who set up a business together and manage their local capital (including natural resources, know-how, finance, and sociocultural heritage) to trade products or services so that they can earn an income and be self-reliant." (Secretariat Ofiice of Community Enterprise Promotion Board (SCEB) c.2015 in Chudsari, 2018, p. 84).*

This definition is reflected in all three survey locations in terms of geographical matter. The area of stitch-resist dyeing practice is also located in one area. The practices in Palembang are located in one area, Tuan Kentang hamlet; while the practices in Yogyakarta and Banjarmasin were initially located in one area, and then they have begun to spread out to different areas. The initial location transformed into outlets for people to purchase the cloths and also for tourism, which is later explained as one of the creative ecologies (section 6.2). The craft makers adapt and transform the socio-cultural heritage of each location into stitch-resist dyed cloths to make a living. All three areas utilise the technique for manufacturing stitch-resist dyed cloths in significant numbers. Although the craft makers in Jogjakarta do not produce as many cloths compared to the other two locations; they nevertheless have a similar future goal as the other locations. The shorter establishment years of craft industry in Yogyakarta compared to other locations was assumed as the possible cause for the low production level. The following sections discuss the commercialisation effects on three

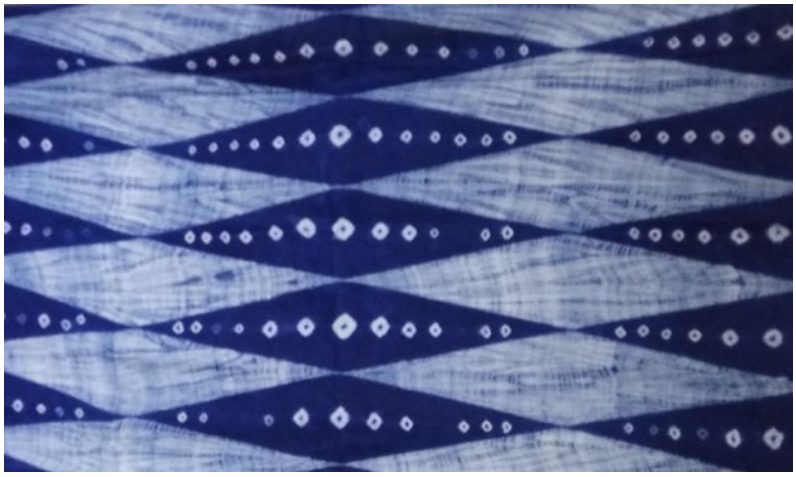
main factors: the pattern aesthetic, the craft makers' welfare, and the workshop facilities.

6.1.1 Transformation of the Indonesian stitch-resist dyeing pattern aesthetic

The manufactured goods in all three areas show a great connection to their root, especially in terms of design, an adaptation of patterns and compositions, and also the technical methods. The stitch-resist dyed cloths represent the social and cultural value of the people in the community, and the pattern designs illustrate their authentic aesthetic values. The stitch-resist dyeing practice in all three locations shows a correlation with their historical background in different ways. The craft makers in Palembang and Yogyakarta adopted their heritage as a method to produce a commodity, where the Banjarmasin craft makers embrace the historical value and perceive the designs, products and practices proudly as their cultural heritage. These different standpoints are reflected in the development in each area, which is described in the following paragraphs.

The craft makers in Palembang continue the practice that has existed in that area from trading activities in the past. Most of the craft makers are not originally from Palembang, but moved there and saw the opportunity to continue the practice when the native people were unwilling to continue the tradition. The practice of making *pelangi* cloth relates more to the location, Palembang city, than to the craft makers. One of the participants who was originally from Java mentioned that he did not want to produce *pelangi* cloth when he temporarily moved back to Java during an economic crisis in 1997. The reason that he implied was because the *pelangi* cloth belongs to Palembang, and it would be inappropriate if it was produced in Java. Most of the craft makers treat the cloth as a commodity, which explains how the pattern design is developed into a less ornamental design compared to the traditional design. The main reason is to reduce the duration of the making process and also the contemporary market's drive, which prefers simple and monochromatic combination to intricate and colourful. The low desire to pay more from the customers also forces the craft maker to simplify the design. This also affects the technical sequence where the majority of Palembang craft makers employ plastic bags as part of the colouring process to shorten the process (see section 4.4.3).

Resonating with the practice in Palembang, the stitch-resist dyeing practice in Yogyakarta also adapt only the method of past traditional cloths, *tritik* cloth and *kembangan* cloth. The method was called *jumputan*; thus the cloth is now well-known as *jumputan* cloth. The community now refers the technique as *batik jumputan*, which refers to a textile method that has a similar colouring process to *batik* but utilise stitches and knots as the resist methods to create resist areas instead of the hot wax. The design of *batik jumputan* cloth does not strictly related to the traditional *tritik* and *kembangan* designs. The practices of making *jumputan* cloth are centred in *Kampung* Tahunan, (*Tahunan* village) and recently held the first *Batik Jumputan* parade cloth to promote *batik jumputan* cloths.



(a)

(b)

Figure 6.1 Example of *jumputan* designs that had adapted the *shibori* method in combination with *jumputan* technique in Yogyakarta

Description: both images are coloured with natural dyes and made by Tizania *jumputan* from Yogyakarta. (a) *Jumputan* was combined with *itajime shibori* and (b) *Tritik* and *jumputan* was combined with *awase-nui shibori* and *nui yoro shibori*. Images were provided by Tizania *jumputan* from their documentations in May 2020.

Being situated in Yogyakarta which is the centre of *batik* making has had a significant impact on the stitch-resist dyeing evolvement in that region. Based on the respondent answers and observation, the craft makers in Yogyakarta are facing more competition from the *batik* making industry more than other areas. In addition, being located on Java island, as the most developed island in Indonesia (Gillow, 1995), has given a great impact on the practice by providing an easy access to material and also information. It was noted during the survey that some of the craft makers in Yogyakarta explore and combine the traditional techniques such as the stitch-resist dyeing with *shibori* technique from Japan. The skill of *shibori* technique was gained by the craft makers through in person training and also an online demonstration from the internet. The clamping technique (*itajime shibori*) (Figure 6.1a), stitched pleating technique (*nui yoro shibori*) (Figure 6.1b), and *orinui shibori* have been adapted to the Indonesian practice in Yogyakarta which results a different aesthetic from the traditional cloth (Figure 6.1). (Wada et al., 2011) However, the cloth is still called *batik jumputan*. The initial reason for this adoption was the close relationship between both the *jumputan* and *shibori* methods, as both involve the tying process (Wada, 2002). In addition, some craft makers also explained that the combination with other techniques allowed them to explore new aesthetic and produce an innovative pattern, thus it supports them to standout in the market competition.

As explained in section 4.5.1, the beginning of *sasirangan* craft industry in Banjarmasin was driven by the notion of creating a local cultural heritage from the traditional spiritual cloths, *pamintan* cloth, while encouraging women empowerment in that area (Redho, 2016). The development of *sasirangan* cloth has rapidly increased with support from the external environment, i.e. the local government and community. The establishment of an annual *Sasirangan* festival that is linked to another well-known festival, *Pasar Terapung* festival, and the associated design competition have given a significant impact to the *sasirangan* development (Rohayanti, 2019). Beside the promotion role, the event also encourages the craft maker to

produce delicate and exclusive *sasirangan* cloths (Rohayanti, 2019), which elevates the value of *sasirangan* cloth in the society. By producing a more delicate design, *sasirangan* cloths can be considered as a *kriya* product; this relates to the product diversification of *kriya* and *kerajinan* (section 1.1.1). The creative ecology of stitch-resist dyeing practice in Banjarmasin demonstrates a full support in sustaining the tradition in long term (Dillon and Kokko, 2017).

6.1.2 Commercialisation effects on the economic activity

The commercialisation has brought a bigger market to the stitch-resist dyeing products which also has led this craft practice into a semi mass-production type. The stitch-resist dyeing products has been classified into two categories: retail and customised products (see section 4.4.1). Each product has different characteristics. The different traits of each product category is outlined in Table 6.1.

Table 6.1 Traits of stitch-resist dyeing products: retail and customised

Trait	Retail products	Customised products (corporate wear)
Design creator	The craft maker	The customer with suggestions from the craft maker
Design	Intricate and delicate design, exclusive or limited product, individual requires diversity	Simple and uniform design, mass product, represent of group identity
Materials	Various textiles	Affordable and obtainable materials
Dyeing Process	More explorative dyeing process, e.g. the use of natural dyes, an application of more than two colours combination using synthetic dyes	One or two colours combination using synthetic dyes
Duration	± 2 – 5 weeks for one piece	2 – 5 weeks for ± 100 pieces
Quantity	One piece	10 – 500 pieces
Price	Individual price	Batch price

Trait	Retail products	Customised products (corporate wear)
Consistency of product	Sold as single piece; consistency between cloths variable	Sold in batch; Must be highly consistent

For retail products, the design is determined by the craft maker's creativity to produce an exclusive or limited unique design. Although there are also retail products that produce multiple repeats and sell at a lower price; however, the design was produced individually. Most of the craft makers' creations are driven by market demand. Almost all craft makers in the three areas manufacture for corporate wear, only a few of them have decided to focus only on exclusive retail products. The exclusive designs were created by utilising more sophisticated approach compare to other craft makers' method, for example, the use of natural dyeing process which considered as complicated method, and the use of an exclusive artisan design (e.g. Figure 4.8b, Figure 6.1a, Figure 6.1b).

In comparison, the design for customised products complies with the customer request. The customised products can be made for an individual order, but most of them come in significant quantities (i.e. 10 - 500 pieces) within one design. One of the customised products' purpose is for corporate wear. In general, corporate wear in Indonesia can be defined as a set of shirt and trousers for men; and a set of blouse and trousers or skirts for women. Regarding the corporate wear policy for Thursday and Friday's uniforms (PERMENDAGRI, 2016), the traditional textiles can be tailored into shirts for men, or into blouses or dresses for women (see Figure 1.4).

The demand for customised products has been expanded into non-related corporate wears with smaller quantity compares to corporate wears quantity; for example, family uniform (Figure 6.2) or wedding bridesmaids. Even so, that demand still requires a uniformity. The design is usually simpler and less personal because it shows more the group identity than an individual characteristic. A simpler design was made with the main intention to reduce the production time. As it is illustrated in Table 6.1, production time for one piece of retail product with an exclusive design takes the same time to produce 500 pieces with a simple design traditional cloths for corporate wear. In addition, creating simple design for corporate wear also reduces the possibility to have any pattern defect. In term of pattern quality, the existence

of corporate wear demand has created a challenge for the craft makers as they need to attain more consistent and uniform products. In this type of product, any inconsistency in the pattern is considered as a defect to a certain extent.

Figure 6.2 An example of customised products for family uniform.

The image shows the customised products for Ndari's family uniform made from *jumputan* cloths by Tizania *jumputan*, Yogyakarta, 2018. Image was provided by Tizania *jumputan* from their documentations in May 2020.

The manufacturing goods process and the commerce systems explained in section 4.5.2 are interrelated and inter dependable; it means both systems have the same importance to make the whole economic activity successful. Unfortunately, in the Indonesian stitch-resist dyeing practice, the expanded market after the commercialisation is not supported by the good commerce system. The perceived value of the stitch-resist dyeing cloths in the society is still considered as low. The customers are sometimes reluctant to pay a high price for a piece of stitch-resist dyed cloth, despite the long-preceding process and the sociohistorical background of the traditional cloths. This situation was referred as a cycle by Triharini (2014) where the customer

wants cheap crafts that forces the enterprise owners to set a low production margin which means craft makers have less time to work and details are neglected. In result, low-quality crafts are produced and crafts are sold at a low price (see section 4.6.2).

That cycle illustration has happened among the Indonesian stitch-resist dyeing makers. The situation has forced the stitch-resist dyeing craft makers to reduce the price of their cloths based on the customer willingness to pay, which affects the wage of each role. During survey in 2016 -2017, the price range of stitch-resist dyed cloths is from 70,000 – 250,000 Indonesian Rupiah (IDR) or approx. 4 – 14 GBP per cloth; the exact price depends on the design. The idea of having a high quantity number of sales with low profit was considered tempting in the short term but it will degrade the value of the artefact itself in the long term. Low price puts the artefact in a quite low position in terms of value versus cost. This can be categorised as a labour of love product where the artefacts are costly to produce in term of the time-consuming and complicated process but have a low perceived value (Martin, 2017, p. 55).

From all the roles involved in the entire process based on the organisational structures in section 4.5.3, the stitchers are considered to have the lowest wage compare to other roles. The stitcher receives a payment around 8,000 – 10,000 IDR or approx. 0.4 - 0.5 GBP per cloth, which only 8% - 10% from the cloth selling price. The low wage shows very low appreciation of the stitchers work, considering their work plays an important part and the most time consuming from the entire process. On the other hand, the stitcher's unreliability in delivering the working order in time because of domestic reasons has been interpreted as unprofessional attitude. The low wage paid to the stitchers may explain the poor welfare of the craft makers. Although, one interviewee from Banjarmasin who is the stitcher mentioned that having a nine to five job that requires her to work outside house would bring problems in the domestic side and it is not worth the money, even it is higher than she earns now.

An improvement for the stitcher welfare can be made by having an exclusive contract between the enterprise owner and the stitcher. It means the stitcher only accepts an order from a particular enterprise owner. This model can improve the wealth of stitchers because they would have a continuous order, which implies a fixed income. This model has been conducted by the owner of Ori *sasirangan* enterprise by employing permanent stitchers who only

work for them. This working agreement also allows the enterprise owner to acknowledge the work of the stitcher; which opens up the opportunity to train and increase the stitcher skill. Some organisational structures that have a distributor do not accommodate a personal connection between stitcher and enterprise owner which lead into a lack of appreciation into the stitchers' works.

Apart from several issues that explained above, the craft makers' low welfare can also be related to their organisational structure. From the two types of organisational structure explained in section 4.5.3, each type has advantages and disadvantages. The enterprise type shows a hierarchical structure where the enterprise owner has the highest authority and from the economic points of view also earn the highest profit. On the other hand, the cooperative type applies a flatter structure where all the members are on a similar level; which means more economic fairness between members. In terms of the decision making process, the cooperative type tends to have a longer process in decision making because more people are involved to make a decision, where the decision in enterprise type is only made by the owner. However, the advantage of each organisational structure type is depended on the craft makers' culture. For example, the cooperatives type is applicable in Yogyakarta because the majority of craft makers are housewives; it is easier for them to arrange the activities around their schedule.

The other critical point from the commerce system in Indonesian stitch-resist dyeing practices is the role of enterprise owner. The majority of enterprise owners have multiple roles, not only acting as a seller but also as a production manager, a designer and also a dyer. These roles are not supposed to be conducted by one person because each role requires different expertise, and less skill can cause less performance. The enterprise structure type B in Banjarmasin (section 4.5.3) illustrates a good example in splitting the role between enterprise owner as an actor who sells the goods (or sometimes also a designer) and the dyer acts as the production manager. This can lead to a market expansion and a better quality of commerce service especially when dealing with two types of customer: the retail customers for retail products, and customised customers for corporate wear. Each customer requires different attention. This type of enterprise demonstrates a good practice as long as the enterprise owner does not take advantage of the craft maker, which can cause even poorer quality of craft

makers' welfare. In addition, most of the enterprise owners and group leaders, though not all of them, still apply a conventional way of marketing their goods. The majority of them rely on market expansion through word of mouth, selling by hands in the neighbourhood, selling through retailers, and through trade fairs.

6.1.3 Underqualified dyeing facilities for the Indonesian stitch-resist dyeing.

As it was discussed in section 4.5.1, the stitch-resist dyeing practice commonly takes place in the craft makers' residences and merges with their domestic activities. Based on the observation, the home-based dyeing facility is underqualified which can be related with both issues: low quality of the resultant pattern and lower standard of living for the craft makers. The existing workshop facility does not support a high quantity production scale and also does not provide a safe environment for the craft makers, people in the neighbourhood or local environment. For example, most of the working areas in Palembang are taking almost all spaces of their residences or expanded into the small alley outside. In addition, the workshop also does not support the dye waste treatment facility which will cause potential harm for the environment in long term. One craft maker from Palembang admitted that he has been experienced respiration problems since conducting the dyeing process. It can be effected from the high reactivity dyes and lack of personal protection equipment.

This underqualified facility could also contribute into the image of cheap product, which relates to the low price from customer. The customer in this context can be the retail customers or the resellers. This seems to be cause by another cycle: the lack of capital and the insufficient knowledge of production are related to the poor production facility. The poor production facility is correlated to the poor production quality and low social status. At the end, these situations result a low bargaining position of the craft makers to sell the product in higher price. The issue with facilities are considered as urgent in terms of the craft makers' welfare and environmental issues.

6.2 An analysis of existing initiatives of Indonesian stitch-resist dyeing practice

After discussing the main issues of stitch-resist dyeing practice after commercialisation in relation with the creative ecology in each location, this section aims to analyse the existing initiatives carried out by the stakeholders in each location. This study attempts to sustain or transform the stitch-resist dyeing technique without contradicting the existing initiatives of culturally significant design, products, and practice in Indonesia. The Design Routes (Evans et al., 2018) were adopted for this study as the foundation for structuring the position of this study and the suggested strategies. It is important to be in line with the current strategies to ensure maximum benefit for the community, in this case, the Indonesian stitch-resist dyeing crafts makers. Thus, the discussion begins with an analysis of existing creative ecology and revitalisation strategies following the Design Routes revitalisation strategy taxonomy based on survey findings described in chapter four. The findings from this section lead the discussion on appropriate revitalisation strategies for the traditional craft practices in section 6.3.

The Design Routes taxonomy has eight clusters of revitalisation strategies that are interconnected and interdependent which means they could be applied independently or dependently (Evans et al., 2017). However, a combination of multiple strategies is strongly recommended to be conducted in order to achieve a sustainable and meaningful revitalisation which also can lead into an original and innovative artefact (Evans et al., 2017). Each cluster is further divided into sub-clusters which address more specific strategies, details of each cluster has been described in section 3.5. The following sections analyse the existing revitalisation strategies starts with the five primary clusters (section 6.2.1) and then followed by the three supplementary clusters (section 6.2.2) on the Indonesian stitch-resist dyeing practices.

6.2.1 Existing initiatives of the Design Routes primary clusters on the Indonesian stitch-resist dyeing practice.

The analysis of existing revitalisation strategies of the primary clusters was identified in the three survey locations. The summary of existing initiatives

carried out by the craft makers or stakeholders are presented in Table 6.2 (adopted from Titisari, et. al, 2019). From five primary clusters of revitalisation strategies explained in Table 6.2, Banjarmasin shows a higher existing revitalisation strategies on the stitch-resist dyeing practices compare to other location. The following paragraphs elaborate each clusters by discussing some existing initiatives relate to the previous discussion of creative ecology.

Table 6.2 Analysis of existing initiatives on the Indonesian stitch resist dyeing practices (adapted from Titisari, 2019).

Revitalisation Strategy Clusters		*Sasirangan* Craft Practices	*Pelangi* Craft Practices	*Jumputan* Craft Practices
1 Sustain Through Design	1. Remix design elements linked to traditional making practice	√	√	√
	2. Reintroduce design associated with traditional making practice	√	√	√
	3. Rework design to meet contemporary needs	√	√	√
	4. Mashup with "external" traditional design elements	√	√	√
	5. Introduce fresh aesthetic to traditional making practice	√	√	√
	6. Create a new product based on the traditional archetype	√	⊗	⊗
2 Transpose Tradition	1. Reinterpret traditional pattern using new making practice	√	√	√
	2. Reinterpret traditional form using new making practice	√	⊗	⊗
	3. Apply traditional making practice to new product type	√	⊗	⊗
	4. Transfer traditional making practice to a new material	√	√	√
3 Value Place	1. Introduce traditional making practice in a new place	⊗	⊗	√
	2. Reintroduce lost making practice in the relevant historical location	√	⊗	⊗
	3. Utilise local materials	⊗	⊗	√
4 Production Process	1. Develop production capability to increase output	⊗	⊗	⊗
	2. Improve quality and consistency production process	⊗	⊗	⊗
	3. Enchance production process using new technology	⊗	⊗	⊗
5 Skills	1. Transmit making skill from person to person	√	√	√
	2. Create and access enduring record of skilled making practices	√	⊗	⊗
	3. Design material, tool or kit to support development of making skill	√	⊗	⊗
	4. Develop the skill to complement making practice	√	√	√

Cluster one, the sustain through design cluster, has the highest number of existing initiatives in all three locations. This cluster is a group of strategies that combine traditional making or used practice with new or reimagined design (Evans et al., 2017). The exploration of stitch-resist dyeing designs was an initiative conducted by the craft makers and also supported by the Indonesian government. The new designs created by the Banjarmasin craft makers for the design competition are the right example of this cluster, i.e. rework design to meet contemporary meet sub-cluster.

The collaboration between a group of designers and craft makers has brought a major impact to create a new design that more fitted to contemporary market (IKKON, 2019). Banjarmasin was one of area that involved in this programme in 2016 (IKKON, 2019). On of result from IKKON programme was a design development of in natural dyeing process of *sasirangan* cloth (Redho, 2016). Other training programmes supported by other institution also contribute in the design exploration, e.g. the combination of stitch-resist dyeing with *shibori* technique in Yogyakarta. This initiatives can relate to the remix design elements sub-cluster that link to traditional craft making practice.

The second cluster, transpose tradition cluster, is a group of initiatives that attempt to transform the traditional design or making practice into a new context (Evans et al., 2017). This cluster is very strong related to the first cluster, sustain through design. For example, the initiative of employing natural dyeing process can also be considered to this second cluster because the use of natural dyeing was not very popular among the stitch-resist dyeing makers based on the survey results (see Figure 4.20). This new approach is considered as a new making practice for some craft makers. This shows the example that each strategy in this taxonomy is interconnected and sometimes interdependent. The third cluster, value of place cluster, focuses on bring up the value of place and provenance of existed practices. This cluster are related with the initiatives that craft makers in Banjarmasin did in terms of adapting the *pamintan* cloth into *sasirangan* cloth and also the transformation of *Sasirangan* village as the iconic place of *pamintan* cloth. The development of *Tahunan* village and the carnaval towards that area by the craft makers in Yogyakarta also considers as one of strategies in this cluster.

The initiatives that relate to the production processes cluster are not existed in three locations. An implementation of methods or tools by some craft

makers is not considered to this cluster because the aim was to create different patterns or forms. These initiatives are related to cluster one, sustain through design, and cluster two, transpose tradition. This cluster employs appropriate and effective methods of making towards the traditional one with three specific objectives: (i) to increase the production capacity which means a higher volume of output; (ii) to improve quality and consistency of manufacturing processes; and (iii) to innovate the production process with new technology (Evans et al., 2017). Any improvement in the production processes would often have a strong link with the development of makers' skill; which if not handled sensitively, the craft skill and associated tacit knowledge may be lost (Evans et al., 2018). This lack of initiatives in the production process might be linked to the issues of inconsistency in pattern that are faced by the Indonesian craft makers.

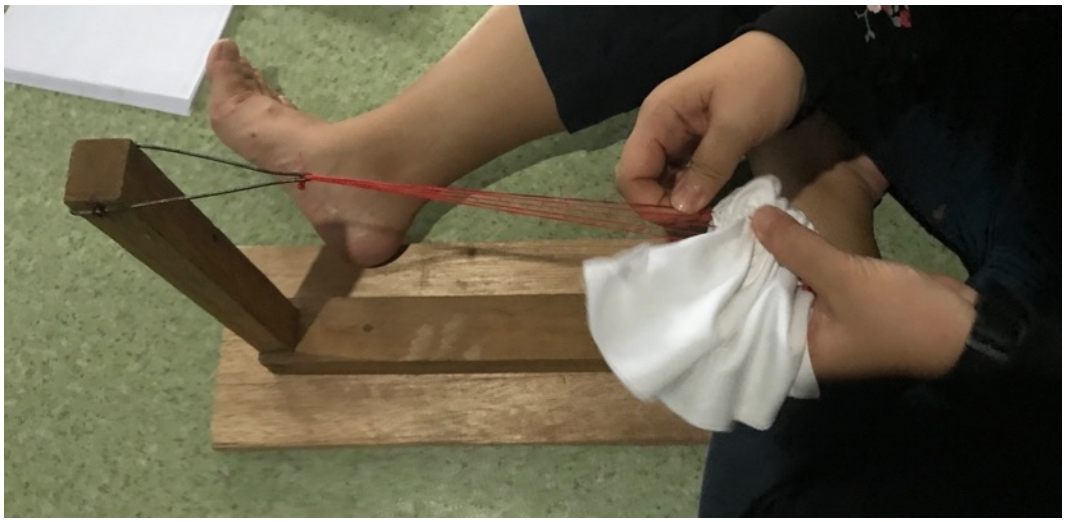


Figure 6.3 A supporting tool to enhance the tightness level in the stitch-resisted area, location: Banjarmasin (photo is taken during survey 2017).

The last cluster of this sections, skills cluster, aims to employ targeted approaches to embed and enhance skills (Evans et al., 2017). Some tools are adapted from similar techniques from a different area i.e. the wooden tools from *shibori* to enhance the stitch-resisted skills (Figure 6.3). This additional supporting tool help the process of gathering and knotting the sewing thread to enhance tightness level in the resist area. An application *jumputan* technique as the extension of stitch-resist dyeing in Yogyakarta

(see section 4.4.2) is also related to this skill cluster, to enhance the stitch-resisted skill of beginners.

6.2.2 Existing initiatives of the Design Routes supplementary clusters on the Indonesian stitch-resist dyeing practice.

The following discussion attempts to examine the existing supplementary clusters in the Indonesian stitch-resist dyeing practice in three locations. The survey findings mentioned before, show the existing of three supplementary clusters (promotion, enterprise, and research and education) on the Indonesian stitch-resist dyeing practices. In term of promotion cluster, the Indonesian government and supported by the community have spread awareness and appreciation via effective promotion; for example the trade fairs, promotional events, tourism events, and social media platform. The Indonesian government has created programmes that fully support any initiatives that related to the enterprise cluster. Those supports are providing an effective business training programmes, giving an easy access to legalised their organisation and the intellectual property, and also the finance support (BEKRAF, 2018). The research and education cluster is related to any initiatives to learn about traditions, meanings, and contemporary relevance to the practices. Some research about the historical story and patterns of each cloth has been conducted at the national level, although the publication of such research has not reached a broad audience (Seman, 2008; Juliana, 2010; Redho, 2016). In fact, this ongoing study could be accounted for as one of the initiatives in research and education.

6.3 Suggested appropriate technology and organisation for the Indonesian stitch-resist dyeing practices

Taking all considerations from the discussion of the creative ecology, the existing strategies and the experimental findings, this study identifies the possibility to solve the issues that are faced by the Indonesian craft makers with appropriate technology and organisation. This can be translated into improving the stitch-resist mechanism and reconstructing the organisational structure. While the explanation of the appropriate technology concept has been presented as the problem context in section 1.2.4, this study suggests

that the appropriate technology should be supported with an appropriate organisation for them to be successful in this context. The application of appropriate technology requires the existence of relevant organisation structure as well, as it stated by (Brunn, 1996) that any improvement in the hard technology, which refers to the tool, cannot be separated from the soft technology or the organisation of the user. In the context of the enterprise community, the suggested tool should consider the nature of collective technology, meaning the technology should give a benefit for the whole community and also relate with the existing structure within the community (Wicklein, 1998). The quality should be improved from the tools and the people, as the executor, because the main idea of revitalisation strategies of these practices is not to reduce the man-power of craft makers.

The contemporary term in this context refers to innovative practices that extend beyond the existing practice in Indonesia. The first aim of an application of appropriate technology is to improve the pattern quality and reduce the risk of pattern defect of Indonesian stitch-resist dyeing resultant patterns. The issue of pattern inconsistency is particularly problematic due to the high craftsmanship skill required in the resist mechanism part which involves stitching, pulling and knotting. The whole process of the stitching mechanism is done by hand, using only thread and needle. The stitching process needs to be consistent on the length. The knotting process needs to be consistently tight, and it requires high craftsmanship skills; the lack of this skills can cause a loose knot. Up until now, the development of skill in the stitch-resist dyeing practice is not supported with an appropriate tool.

As resulted from the experiment in chapter five, the nature of the knotting mechanism did not consistently hold the pressure between two knots firmly throughout the dyeing process (see section 5.3), which leads to unpredictable results. However, in the short term, the improvement of pattern quality can be attained in individual level by making sure the knot is fastened enough and then measuring the length of the knotted fabric with the measurement method that was established in section 5.6. The measurement method only requires a simple tool such as a ruler, to measure the pattern length, the fabric thickness and the stitch length. The next step is to calculate the value of each measurement into the equation to obtain the expected length of knotted fabric (see section 5.6). By knowing the expected length of knotted fabric, the craft maker can control the final result to be consistent. Although, the accuracy level of pattern repeatability

using this measurement method is relatively low; it means it would not ensure the exact similar pattern between each cloth. However, it would at least reduce the risk of pattern defect: losing some parts from the pattern.

For a greater improvement, this study explores the possibility of applying a supporting tool as an appropriate technology for resist mechanism in this case. Therefore, several frameworks of appropriate technology in developing countries have been studied (Bowonder, 1979; Brunn, 1996; Wicklein, 1998). Since the characteristic of developing countries present some similarities with the case of Indonesian stitch resist dyeing craft practices, this study adapts methods by Wicklein (1998) in selecting the appropriate technology for traditional craft practices. There are seven categories that need to be considered to design the appropriate technology for practices in developing countries. Those categories, in no particular order, are: (i) systems independence; (ii) individual technology versus collective technology; (iii) cost of technology; (iv) single-purpose or multi-purpose technology; (v) risk factors; (vi) evolutionary of capacity of technology; and (vii) image of modernity. Table 6.3 shows all important points that need to be considered in designing appropriate technology for the stitching mechanism (Titisari et al., 2019). The working culture and also the stitcher's role of entire stitch-resist dyeing process is taken into consideration on deciding the recommended appropriate technology. This step is performed by the stitchers who mainly are housewives; working individually or gathering in a small group while doing domestic work. The working culture performs in a casual circumstance by sitting on the floor without a desk or chair, usually at the stitcher's living room (Titisari et al., 2019).

Table 6.3 Analysing appropriate technology categories for the Indonesian stitch-resist dyeing (adapted from Titisari et al., 2019).

The seven categories of designing an appropriate technology were adapted from Wicklein (1998).

Appropriate technology categories	Recommendation appropriate technology for Indonesian stitch-resist dyeing
Systems independence	A simple tool that only requires moderate changes and improvements of existing systems for implementation.
Individual technology	The technology development needs to be

Appropriate technology categories	Recommendation appropriate technology for Indonesian stitch-resist dyeing
versus collective technology	designed so that an individual or single-family unit can operate and afford the technology.
Single-purpose and multi-purpose technology	A multiple purpose tool that can be used in every step of resist mechanism (stitching, pulling and knotting) and revealing process. The tool needs to be fast, consistence, and user-friendly
Cost of technology	Using a low-cost material, manual and man-power technology
Risk factor (internal and external)	The use of a new tool needs to be adaptive to the local production system, a similar procedure to the existing technique
An evolutionary capacity of technology	The new tool needs to have a capacity to evolve in design creativity, quality and quantity
Image of modernity	A new tool or method that can elevate their social status

Taking all the important points from the stitcher's working culture into the seven categories of appropriate technology, the improvement of the production process can be achieved by making a simple and individual tool with low-cost multipurpose technology. It is also expected to not change the existing working culture to minimise the internal risk factor. It means the technology should be portable (i.e. not required a desk or chair to perform) and with a similar mechanism to manual stitching and knotting. The low-cost technology needs to be affordable for the craft makers not only to purchase but also to run and maintain the manufacturing process in the long term. Additionally, an image of modernity could be obtained by introducing the new tool to society. Thus, this concepts are implemented on three suggested revitalisation strategies in following sections.

6.3.1 Contemporary method for the Indonesian stitch-resist dyeing technique

The first suggestion for the Indonesian stitch-resist dyeing is to employ a substitute mechanism or a tool on the step F (knotting the pulled thread) that

works as a stopper (Figure 6.4). This suggestion is constructed based on the survey and laboratory experiment findings, and also by considering the critical points about appropriate technology. An application of substitute knotting mechanism has two objectives, which are (i) to solve the production issues that explained in section 6.2.1, and (ii) to create a new aesthetic from stitch-resist dyeing pattern. The first objective is referred to the pattern inconsistency issues which includes the loosen knot, inconsistent sewing technique, uneven pleated fabric when they gather the sewing thread, and torn fabrics (see section 4.6.1). This method does not require the use of seam ripper or scissors to release the pressure of the resist (Figure 6.4b2). This implies that the risk of having a torn fabric can also be reduced. The finding in chapter 5 shows that the knotting mechanism is the most critical point of the stitch-resist dyeing technique that need to be improved to increase pattern quality and consistency. From the appropriate technology point of view, this substitute tool represents an individual, portable, and easy to perform tool. Therefore, the tool would presumably have less impact on the existing stitcher's working culture.

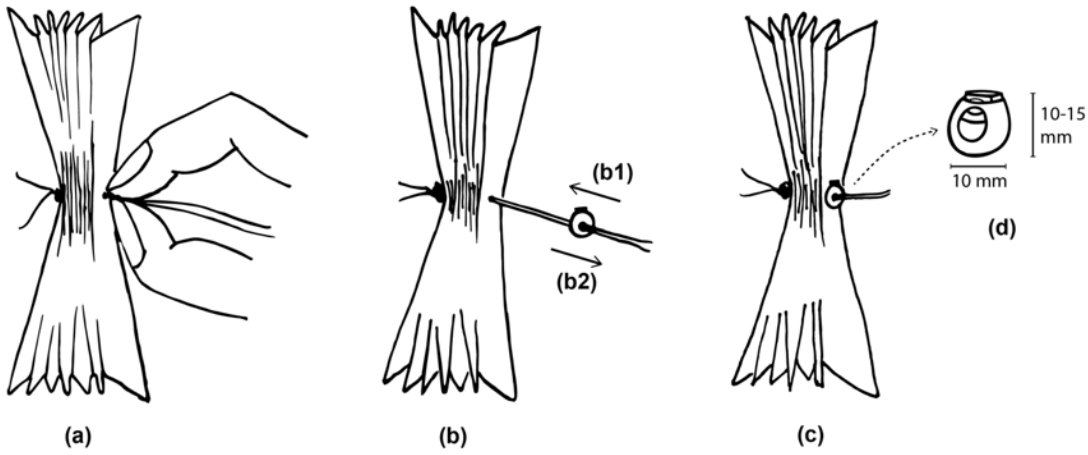


Figure 6.4 An illustration of a substitute mechanism on step F (knotting the pulled thread)

The suggested stopper mechanism is inspired by the use of a cord stopper in a garment. An illustration of suggested stopper mechanism is provided in Figure 6.4. The cord stopper is functioned to secure directly at the opening of the drawstring casing or adjusts in length (see Figure 6.4b1 and Figure 6.4b2). The application of stopper will substitute the basic knotting process

(Figure 2.10) with a method that would have less risk to slip through the sewing thread if it has the right specification.

Having said that, a future study to produce the suitable stopper is required because the existing stopper in the current market is mostly designed for the cord. The cord has a bigger diameter than the typical sewing thread, so this study suggests that a recommended size for the stitch-resist dyeing stopper would be approx. 10 – 15 mm (Figure 6.4d). The suggested size was examined based on the pattern requirements. One stitch-resist dyeing cloth would have around 10 – 50 patterns, and each pattern could have more than one line to be secured by the stopper. Therefore, the suggested size is considered to be appropriate for accommodating the complexity pattern in a stitch-resist dyed cloth, and for preventing an additional mark that caused by the stopper without tolerating the tool ergonomic.

In terms of selecting material, it is important to meet the functional requirement which to secure the resist area firmly. Although, it is also more essential that the selected material is affordable with low environmental impact. The environmental requirements can be integrated within the design process by adopting life cycle design (LCD) strategies (Vezzoli, 2013). The LCD aims to reduce the input of materials and energy, as well as the impact of emission and waste (Vezzoli, 2013). Those strategies are by minimising material consumption; selecting nontoxic and harmless materials; selecting renewable and biocompatible materials; and improving lifespan of materials, including design for disassembly (Vezzoli, 2013). These guidelines should be followed when designing the substitute tool for the knotting mechanism. Nevertheless, the following discussions explain the implication on the practice with the use of stopper as a replacement of the knotting mechanism.

The second objective of applying the substitute mechanism is to create a new mechanism that can lead to a different aesthetic of stitch-resist dyeing pattern. Up until now, the established procedure of stitch-resist mechanism in Indonesia has been a linear process (see section 4.4.2). It implies that the resist area is only formed after all the sewing threads are gathered and knotted. Once the stitched and knotted fabric has been coloured, the process of making the stitch-resist pattern is considered as finished. The colouring process is an iterative process, but the stitch-resist mechanism is not without applying additional stitches. In result, the resist area colour is mostly the colour of initial fabric. In the case of Indonesian stitch-resist

dyeing, the majority of craft makers start the process on a piece of white fabric and then employ various colouring methods. That process produces a multicolour cloth but the resultant stitch-resisted pattern always remains as white.

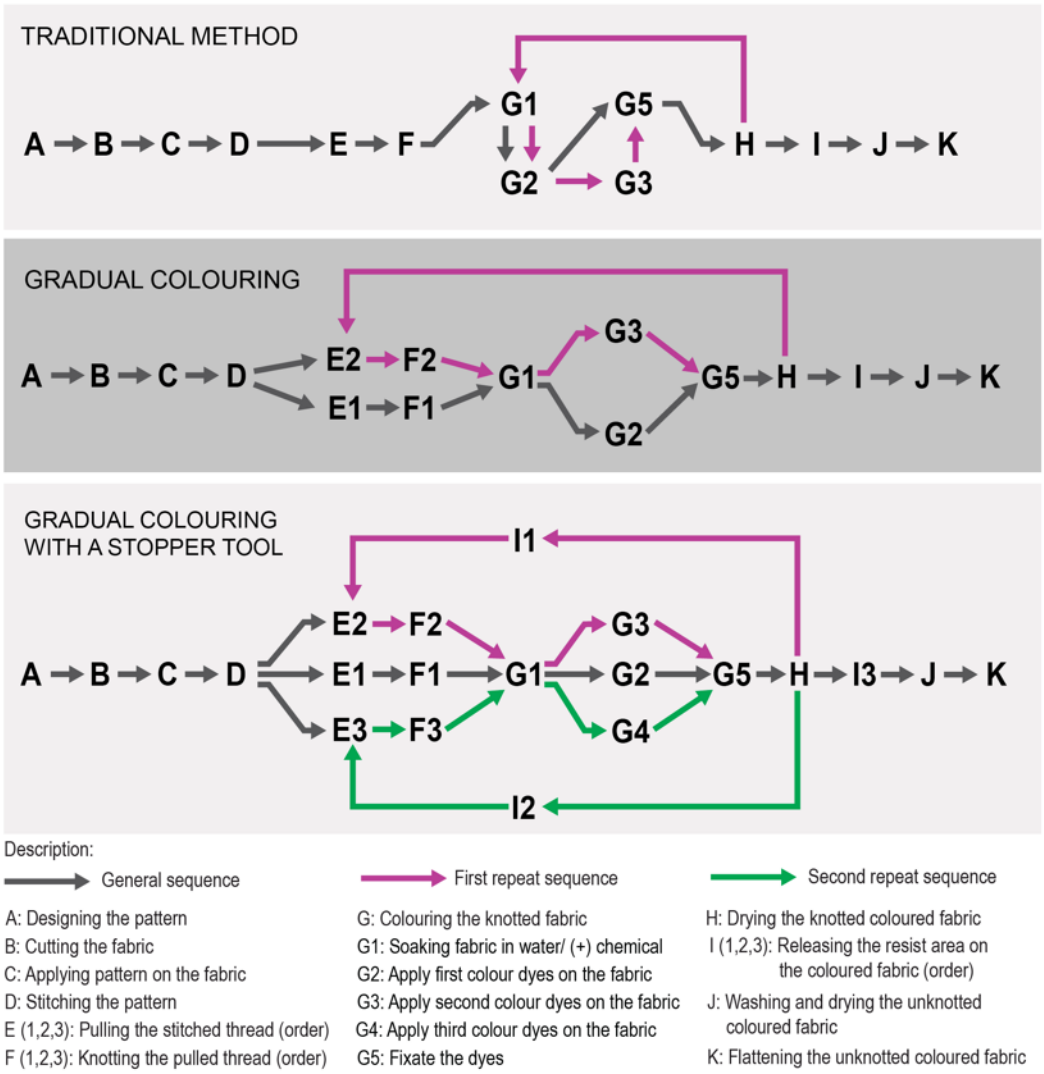


Figure 6.5 A sequence comparison between traditional (above), gradual method (middle), and contemporary mechanism (below).

A sequence comparison between the existing methods with the suggested substitute mechanism is presented in Figure 6.5. The existing methods were divided into two categories in that comparison. The first method was the Indonesian traditional technique that was generated from section 4.4. The second method was the gradual colouring which was referred to a resembling procedure in creating a multicolour stitch-resisted pattern (Maile,

1969). That procedure is conducted by pulling and knotting only some of the sewing threads before the colouring process. The rest of the sewing threads then was pulled and knotted on the second colouring process (Maile, 1969). A similar method was undertaken by Titisari (2012) when exploring the geometrical stitch-resist dyeing patterns (see section 2.3.5).

The stopper tool provides the possibility to apply an iterative process of the stitch-resist mechanism. The repeated sequence can be conducted by taking out and putting back the substitute tool on the sewing thread (Figure 6.4b1 and Figure 6.4b2) in between colouring processes. When the tool is taken out, the resist area is opened and uncovered so another colour can overlay that area. Then, the resist area is closed and resisted, when the tool has been put back without cutting the sewing thread. This process could produce a multicolour stitch-resisted pattern, resulting from an overlaying colour process.

With this new contemporary sequence, the role of the unknotter would be switched from cutting the sewing threads into the opening and putting back the stopper on the sewing threads. This process would require an application of different colour of sewing threads and an additional instruction from the designer to the stitcher. The application of this contemporary procedure could encourage the creation of a new aesthetic of stitch-resist pattern without replacing the authentic patterns. This implies that the stopper mechanism has a capacity to evolve in design creativity, quality and quantity, which represents one of the categories in Wicklein's appropriate technology.

6.3.2 Communal facility centre for the Indonesian stitch-resist dyeing practices

In addition to an application of stopper as an individual tool, the contemporary method could also employ a more precise method in transferring the design process by employing more advance technology. The new approach with computer-aided design (CAD) tool would be considered an advance improvement of technology for the craft makers. In comparison to an application of stopper, this technology does not meet the following categories: low cost, low risk and systems independence. However, the use of a CAD system as a collective technology meets the other categories: multi-purpose technology, an image of modernity, and evolutionary capacity

of technology. This implies that the application of CAD tools has a potential of innovation in stitch-resist dyeing practice if the community is ready to adopt the technology.

This study has conducted experiments with the digital printing and laser cutting process in applying for more precise stitch length position within a pattern design (see section 5.2.1). As it resulted as shown in chapter five, with exact puncture points, the resulting pattern shows more consistency of small circle along the pattern line since it is easier for the stitcher to proceed with exactitude. In addition, it also reduces the duration of the process of applying the pattern on the fabric. The advanced approach also provides a possibility to create a new aesthetic (Figure 6.6). Some of cloths produced using the contemporary stitch-resist dyeing technique were displayed as part of this study at the Indonesian stitch-resist dyeing exhibition at the Foyer Gallery, School of Design (Appendix F). The design adapts the traditional pattern of *sasirangan* cloth and combines with the geometrical illuminating *tritik* method (see section 2.8) creating a contemporary pattern (Titisari, 2019).

Figure 6.6 Neo *sasirangan* cloth (Titisari, 2019).

The context of advance technology is not only referred to the computer-aided design (CAD) tools that mentioned above, but could also refer to an upgrade version of dyeing facility. As it was discussed before, a technique like stitch-resist dyeing only requires a very minimum technology to produce a pattern. Thus, an appropriate facility for a higher quantity production scale is not the main concerned for the craft makers in Indonesia. In comparison with other craft practices, the ceramic maker needs to set up a proper ceramic kiln to facilitate the activity even in small scale. The workshop also requires the urgency of waste management and an appropriate workshop layout (CraftCouncils, 2010). The Leeds printing workshop is one of examples of coworking space among textile makers that accommodates the print makers to utilise the print communal facilities (LeedsPrintWorkshop, 2019).

A high cost and big technology gap is the main consideration that is a barrier to this technology, especially if it is required an individual craft maker scale. Therefore, this suggested revitalisation strategy is recommended to be implemented among community, for example by creating coworking space (co-space) for facility centre. Coworking space is a concept of community that work together in one location, very popular among creative worker (Rus and Orel, 2015). A co-working space centre facility centre could be a strategy for having a community technology that cannot be afforded by individual craft maker, for example for the digital printing and laser cutting for the design transfer process, integrated colouring equipment with waste management, and training facility. Based on the survey, many craft makers transformed their residence into a dyeing facility. For some craft makers who do not have a large area, the dyeing facility was integrated with their house. This situation is not ideal from the health perspective, potential environmental damage, and also production quality. A communal dyeing facility on the community centre could be a solution for those issues, and it is attainable since the dyeing process only takes shorter duration compared with the stitch-resist process. Hence, sharing of facilities can be implemented from a time requirement point of view. By having a facility centre, the revitalisation strategy could be more sustained and resulting a community empowerment.

6.3.3 Worker cooperative of the Indonesian stitch-resist dyeing craft makers

The previous section has described the feasibility and implication of adopting an appropriate technology in the Indonesian stitch-resist dyeing practice. However, appropriate technology requires a support from its soft system, which implies to how the organisational structure among the craft makers, for it to sustain in long term (Sianipar et al., 2013b). In addition, an application of co-working space is based on community (Rus and Orel, 2015). Therefore, this section provides some discussions about an appropriate organisation that could give a solution for the low craft makers' welfare, and relate to the implementation of co-space facility centre.

This study suggests that worker cooperatives could be the appropriate organisation structure that gives more benefit to the community. The existing cooperative type in Yogyakarta is considered as an ideal structure for women empowerment (Walker, 2017), although the worker cooperative can be more beneficial to the whole practices. Worker cooperatives are a type of cooperative where the workers with same value work together and participates the profits and often management of the cooperative using democratic practices (ICA, 2019). It means, all enterprise owners and group leaders are working collaboratively among each other by still keeping their individual practice, to reach a main goal which is sustainable stitch-resist dyeing practices. With having the worker cooperatives, the development of stitch-resist dyeing practices can be conducted on a larger scale, for example by managing the co-space centre facility. In addition, worker cooperatives can regulate a policy between enterprise owners that give advantages for sustaining the practice, for example establish a minimum price of each cloth. It would prevent a worse devaluation of the stitch-resist dyed cloths in the future.

6.4 Implementation scheme of appropriate technology and organisation for the Indonesian stitch-resist dyeing practices

The revitalisation strategies are best suggested to be implemented in partial and incremental stages to the Indonesian stitch-resist dyeing practices. An implementation to society could not be done in one time, and the achievement takes a significant amount of time. The revitalisation process is

not a quick change or instant movement; it is a comprehensive progress that involves layers of involvement from the stakeholders. Having said that, by applying the revitalisation strategy in partial stages, the short term result can be obtained which maintain the long term improvement. Thus, the revitalisation strategies for the Indonesian stitch-resist dyeing are constructed level by level, starting from the most feasible one and then gradually developing to the more advanced improvements. The feasibility of each level was constructed based on the cost, the number of stakeholders involved and duration for implementation. This suggested revitalisation strategies for Indonesian stitch-resist dyeing are structured in three levels: primary level, secondary level and tertiary level. Each level is described in the following paragraphs.

The primary level consists of several strategies. First, the improvement of pattern quality by increasing the individual skill in the knotting process, then it is followed by measuring the length of the knotted fabric with the measurement method provided in section 5.6. This strategy can be attained at the individual level. For more advance improvement, the application of a gradual colouring system can be implied for creating a new aesthetic pattern. This strategy can be attained in individual level with the help of an outsider to provide training. In terms of improvement for the craft makers' welfare, the use of exclusive contract between the enterprise owner and the stitcher can be implemented plus an initiative to establish the worker cooperative between craft makers in each location (regional level).

The secondary level consists of some strategies, which requires an initiative to build the co-space that facilitates the communal production process and also training centre. The next step would involve the use of CAD machines, which are laser cutting or digital printing to improve pattern consistency. This strategy can be attained, ideally after an existing of the co-space facility centre. This step should be followed by a training for using and creating design with the CAD machines. By having the more advance technology, an application of geometrical pattern making by Titisari (2012) can be easier to implement but not limited to it. Next step is a process of creating and implementing a comprehensive training programme specifically for the Indonesian stitch-resist dyeing. With more advanced technology involved, hopefully it can attract younger generation to involve in these practices.

The tertiary level is considered as an advanced strategy because it requires of involvement of more stakeholders (government, academia, community).

The strategies are involved a research for designing the prototype of a stopper mechanism tool. This research is followed by an evaluation of implementing the stopper tool among the craft makers. The use of new tool will lead to an exploration and establishment of new contemporary patterns using stopper tool. All revitalisation strategies mentioned above can be implemented in different places apart from the three survey locations to sustain and preserve the stitch-resist dyeing technique. The expansion can form an establishment of the producer cooperative between craft makers at the national level.

6.5 Summary

The transformation of stitch-resist dyeing technique has been effected differently in each location. The creative ecology in each location has triggered the beginning and shaped the future of the stitch-resist dyeing practices. Based on the survey findings, the majority of craft makers have shown some attempts to combine the traditional design with a modern approach, as an implication from market demand and also from a creative channel such as the annual *sasirangan* design competition. All phenomena in every location indicate that the craft community is open to a new aesthetic, new approach or technology.

The practice of making *sasirangan* cloth in Banjarmasin shows the strongest attachment with the social-cultural values. The combination of the willingness from the craft makers, the community support in the promotion, and the government support in tourism provides good positive energy to the development of *sasirangan* cloth. Most of the craft makers maintain their new development by holding on to their roots. In contrary, the practice in Palembang and Yogyakarta show weaker attachment with their roots compare to Banjarmasin. The detachment of the craft makers in Palembang and Yogyakarta from the earlier historical background could lead to a threat for the tradition in the future. In addition, a sustainable business without the support of creative ecology around the craft makers, especially in Palembang, can threaten the practice in the long term. Lowering the cost could give long-term damage by marginalising the practice while adopting an entire foreign method could also threaten the entire authentic feature of the traditional cloth, even the identity.

The market demand and also government policies show a significant influence on the direction of stitch-resist dyeing development by creating a potential market into the stitch-resist dyeing practice. However, pure economic drives could jeopardise the existence of stitch-resist dyeing practice in the future, for example, the simplified design transformation by the craft makers Palembang that was mostly driven by market demand. An illustration of contemporary stitch-resist dyed cloths influences is presented in Figure 6.7. It is shown that the intrinsic and extrinsic factors of creative ecology have affected the cloths and how the progress of retail products and corporate wear products are going in a different direction in term of sustaining the culturally significant designs, products, and practices in the long term. The nature of corporate wear products which require homogeneity, repeatable, quick delivery, and low cost, has suffered the craft makers in meeting the requirements. The commercialisation also has given impacts in terms of the craft makers' welfare which is the combination of low social situation and underqualified facilities.

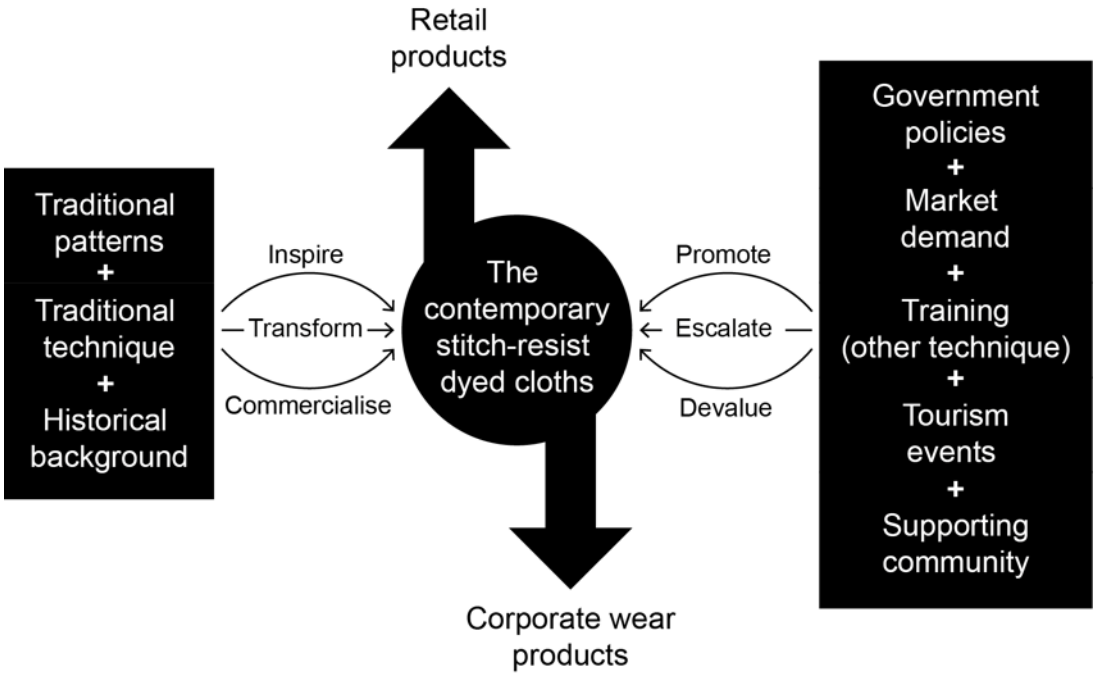


Figure 6.7 A diagram of contemporary stitch-resist dyed cloths influences.

Some revitalisation strategies of appropriate technology and organisation were discussed in this chapter. The main principle of the revitalisation

strategies is the incremental and partial stages in applying of each strategy. The craft makers have the full right to accept or to elevate the improvement for their practice. The drive is better to come from the internal factor, the craft maker themselves, and not from the external factor, the stakeholders, the Indonesian government, or the customers. The more advance application gives a more considerable effect on their social-cultural aspects, but it also could improve the quality of resulting products, which support the artisan life. By supporting the artisan life, it means sustaining the stitch-resist dyeing practice. The suggestion of revitalisation strategies from this study is designed as an option, and the craft maker does not require to utilise all the suggested strategies. Subsequently, the new proposed technology would require further works by conducting a series of empirical experiment to examine the improvements in the consistency and quality of the resultant pattern, also the new aesthetic. Finally, the results would require an evaluation from the community, for example, by running focus group discussions or extensive workshops among the Indonesian stitch resist dyeing craft makers. The following chapter provides the general conclusion from this study and recommendations for future studies.

Chapter 7
Conclusion and future work

This chapter offers conclusions from all the chapters of this thesis. It starts by outlining how the study met the research aims and objectives (section 7.1), and it is followed by providing the general conclusions from reflectively review findings and suggestions to the pertinent issues (section 7.2). This chapter then continues with presenting the original contribution to the body knowledge (section 7.3). The limitations and gaps of this research process are explored in section 7.4, which shed the recommendations for further work that are explained in section 7.5.

7.1 Meeting the research aims and objectives

The research aims are to analyse the Indonesian stitch-resist dyeing technique and practices, and to formulate appropriate revitalisation strategies for sustaining the Indonesian stitch-resist dyeing traditional practices after commercialisation. The research aims are specified into three objectives. The following paragraphs summarise how the research objectives were achieved throughout the thesis.

Objectives 1: To analyse the cultural value, the technique sequence and the organisational structure of the Indonesian stitch-resist dyeing technique after commercialisation in three locations in Indonesia as case studies (chapter four).

The first objective of this study was achieved by surveying three areas in Indonesia, and the findings were presented in chapter four. The craft practices were observed plus related stakeholders were interviewed during the survey. The survey showed that the technique had been adopted from the cultural heritage in each location; then it was developed into cloths that are more suitable to modern life in terms of function and aesthetics. Different resultant patterns in each location alter the technique sequences, especially in the stitch-resist method and the colouring process; which also affect to

material selection. An increasing scale of production has transformed the stitch-resist dyeing from individual practices into collective works forming a home craft industry, which incorporate the craft maker's residence within the workplace. The similar motive also gave a challenge for craft makers to maintain the quality and produce high uniformity products for corporate wear, thus the craft makers are having an issue of inconsistent patterns. This study has examined the existing roles in the stitch-resist dyeing practices in each location and illustrated their organisational structures through the rich pictures that show how the interconnection between them. Enterprise and cooperative structures are practices in three areas with distinct differences in certain roles. Although the practice has increased job opportunities, especially for housewives, however, the craft makers are facing several issues in low welfare.

Objectives 2: To examine the correlation between prominent factors of the Indonesian stitch-resist dyeing technique with the resultant patterns (chapter five).

Laboratory experiments were conducted to reach the second objective, this was discussed in chapter five. This experiment aims to fill a lack of technical information about the Indonesian stitch-resist dyeing method from the survey findings. The laboratory experiments were conducted based on the practices in Indonesia, plus insights from the literature reviews (chapter two). The measurement of clarity for the Indonesian stitch-resist dyeing pattern by the craft makers is subjective. Thus, this experiment aimed to quantify the pattern clarity. Three prominent factors of stitch-resist dyeing were defined for the experiment, which are the stitch length, the depths of shade, and the tightness level on the resist area. The resultant pattern was represented by the lightness value of pattern colour and background colour generated by the MATLAB programme. Later, the generated data was crosschecked with participants' answers in defining the clarity and their preferences in stitch-resist dyeing pattern. From this experiment, the result showed that a combination of three prominent factors affects the resultant patterns, with the tightness level showing the most significant influence for resulting in a high clarity level of stitch-resist dyeing pattern. The majority of participants preferred to have high clarity and consistent stitch-resist dyeing pattern but still show an open-mindedness for a handmade process feature.

In conclusion, the experiment results described the acceptance clarity level of stitch-resist dyeing pattern based on the participants' answers. By understanding the correlation between prominent factors, the causes of pattern quality issue could be identified; thus some solutions were proposed. Furthermore, the experiments examined selected advanced technologies that are not related to the existing stitch-resist dyeing practice to be possibly applied in some part of the sequence. The results showed that the use of computer-aided design (CAD) technology improved the pattern consistency and reduced the production time.

Objectives 3: To identify and construct appropriate revitalisation strategies to accommodate the challenges and sustain the current Indonesian stitch-resist dyeing practices based on primary and secondary data (chapter six).

The third objective was achieved in chapter six, and was conducted in two steps. The first step was to identify the Indonesian stitch-resist dyeing existing creative ecology, and how it has influenced the practices in each location. The identification was constructed based on findings from the survey and the laboratory experiments, plus secondary data. The second step was to analyse the suitable revitalisation strategies to accommodate the issues and sustain the current Indonesian stitch-resist dyeing. The suggested strategies are aimed to be coherent and enhance the existing creative ecology. The appropriate technology and organisation were argued as suitable revitalisation strategies that can overcome the issues of these practices. Recommendations were made on how the craft makers could employ the appropriate technology and organisation so they can improve the resultant pattern quality and consistency, innovate the design, save the ecology, increase their welfare and most importantly, sustain the tradition. The framework provided options in implementing the suggested revitalisation strategies; it can be applied as an incremental process in both individual enterprise or cooperative level. However, each approach can give advantages when it is employed partially according to the craft makers' capabilities.

7.2 General conclusions from the thesis

This study examined how Indonesian craft makers have utilised the stitch-resist dyeing technique in different regions. Based on the survey findings plus related literature, this research has acknowledged the transformation of traditional Indonesian stitch-resist dyeing cloths over the past decades. The Indonesian craft makers commercialised the charming sacred traditional cloths by transforming and compromising the traditional design to fit into a modern lifestyle. The commercialisation was strongly influenced by the globalisation phenomena with significant support from the Indonesian government. The Indonesian government recognises the critical drivers of economic growth and social inclusion through small and medium enterprises (SMEs) and cooperatives, and dedicates a policy priority through national law and specific ministry (i.e. the Ministry of Co-operatives and SMEs) (OECD, 2018; Walker, 2017). In addition, several policies in the creative economy based on the cultural heritage have encouraged and boosted the craft sector to be one of the top three contributions in Indonesian GDP (BEKRAF, 2018). All situations explained above combine with the craft makers' initiatives have shaped the current situation of Indonesian stitch-resist dyeing practices: the era of community enterprise. This study recognised that the creative ecology existing around the practice in each location has triggered the beginning of commercialisation, shapes the current practice and will determine the future of the stitch-resist dyeing practices.

The supportive factors mentioned above have created a high interest and market demand in stitch-resist dyed cloths. The development of Indonesian stitch-resist dyeing design has transformed differently in each area. Utilising the same technique, creations from craft makers in one location have inspired the other craft makers, which has also triggered healthy competitiveness between the craft makers. The craft makers are required to meet the market needs in terms of price, time delivery and more updated design. Thus, the design of traditional Indonesian stitch-resist dyeing cloths that tend to be intricate and colourful has to be converted for the latest market needs. Most of the craft makers in Palembang and Banjarmasin come with an approach of simplifying the traditional design, while the craft makers in Yogyakarta try a different approach by adopting other techniques. Furthermore, the Banjarmasin craft makers have started to create a high

level of craftsmanship in their stitch-resist dyeing pattern as a result of the local design competition initiated by the local government in Banjarmasin.

The dynamic in creating the stitch-resist dyeing design was mostly applied to the cloths that are sold as retail products. While the other type of stitch-resist dyeing product, the corporate wear products, requires a high uniformity of pattern that is repeated in a significant amount of cloths; in some cases it requires a quick delivery time. This order has pushed the craft makers to shorten the production time, which compromises the cloths' qualities, resulting in the issue of inconsistent and poor quality patterns. The study discovered the importance of delivering a high tightness level around the resist area in order to achieve an acceptable pattern clarity (section 5.5.3). The consistency of stitch length and colour shades also influence the resultant pattern.

This study sees a connection between the inconsistent and low quality resultant pattern with the other issue faced by the craft makers: a low income. In reality, the high interest and market demand of stitch-resist dyed cloths do not equal with the customer willingness to pay a reasonable price. Most of the cloths are sold under price, which to a certain extent does not support the craft makers' welfare. The selling price rate overlooks the fact that the practice is a collective work that involves lots of craft makers plus the technique requires a long sequence to produce one cloth. As it was discussed in section 4.5, the majority of organisational structures in three locations are SME's; only Yogyakarta has yet established a cooperative structure. As a community enterprise, the practice in three areas is conducted informally, resulting in lower responsibility between each role. The SME's are organised as a hierarchal structure, which means the income is even smaller at the bottom level. The stitcher is considered to have the lowest wage compare to other roles, although their work plays an important part and the most time consuming from the entire process.

The study observed that the underqualified dyeing facility, which are mostly incorporated within the craft makers' residence contributes to both issues: low quality of the resultant pattern and lower standard of living for the craft makers. Unfortunately, the increasing demand and higher quality level were not supported by an upgraded facility. The current workshop facility does not support the high quantity production scale and manage the waste, especially dye waste treatment. Hence, the facility does not provide a safe environment for the craft makers, people in the neighbourhood or local environment. This

standard of production could harm the ecology in the long term, and in the extreme level, cease the practices. The lack of capital, the low social status and the insufficient knowledge has constrained the craft makers ability to set up quality workshop facilities. This low working environment has deteriorated the Indonesian stitch-resist dyeing craft makers credibility to a point where their professional status is in jeopardy.

Based on the comprehensive analysis, this study recognised that the craft makers' initiatives have been concentrated mostly on the design aesthetic and promoting the cloths. Support from the Indonesian government has been mainly centred on how to elevate the economic growth by reinforcing the financial capital and legal process, upgrading the skills by delivering training and promoting the practice to broaden the market. For example, an allocation of the craft practice in one area in Banjarmasin, the *Kampung Sasirangan*, is mostly emphasised for outlets and promotions as part of the craft tourism.

This study argues that the Indonesian stitch-resist dyeing practices require revitalisation strategies on the appropriate technology and organisation to overcome the issues. The recommendations are referred to a hybrid social innovation approach, top-down and bottom-up, where it involves all stakeholders to participate in this approach (Manzini, 2014). With appropriate technology, the craft makers can improve the pattern quality and elevate innovation in terms of design creation. Several methods on individual and cooperative level have been suggested based on the experiment results. On the individual level, the study advised enhancing the knotting process with a stopper mechanism that substitutes the basic knotting method. The tool is expected to feature a more precise level of pressure than a manual knot. It is also essential that the tool is designed to be affordable with low environmental impact.

In the cooperative level, the practice is suggested to utilise an advanced and eco-friendly technology in a co-working space run by a worker cooperative. This communal space intends to facilitate specifically but not exclusively for the dyeing process. The shared space can be a centre for the entire process by providing the CAD machine to improve the design process. The craft makers can use the facility fairly under the worker cooperative, which means the craft makers are committed to put the worker and community benefit at the core of managing the facility. A suitable training strategy specifically dedicated to Indonesian stitch-resist dyeing techniques is strongly

recommended to be implemented alongside the co-working space. The implementation of suggested revitalisation strategies can be incremental and partial, according to the craft makers' capabilities. Although, each approach can provide an improvement when it is employed partially. The study presumes that implementation of appropriate technology and organisation can improve the quality of patterns and craft makers welfare, generate the best practice, elevate the social status, promote the community development and most importantly, sustain the tradition. However, a pilot study evaluating of each strategy is required before implementing into the community.

The suggested revitalisation strategies were analysed based on the research findings and literature. The researcher was fully aware that her close cultural related background with the research object might affect her perspective in constructing the suggested revitalisation strategies. However, on the other side, having a similar cultural background had helped to understand the local culture and earn the craft makers' trust which provided a richer and more developed understanding of the complex phenomena of the Indonesian stitch-resist dyeing practices. Having said that, the researchers background has given more advantages for this research, and a triangulation approach has been conducted in this research to validate the findings and avoid bias.

7.3 Contribution to the body knowledge

The findings from this research contribute to textile theory and practice, particularly in the stitch-resist dyeing techniques (section 2.1). This study has explained the definition and terminology relating to the Indonesian stitch-resist dyeing technique by comparing the local terms in three production areas in Indonesia (chapter 4). The descriptive analysis of stitch-resist dyeing sequence in Indonesia (section 4.4) and laboratory experiments' results (section 5.4.3 and 5.5.3) has enhanced the knowledge about the stitch-resist dyeing technique. These findings can also be applied to other relevant resist dyeing methods as explained in section 2.8. The extensive knowledge of stitch-resist dyeing would assist designers at a practical level to develop an innovation in terms of design aesthetics and other researchers at a theoretical level to understand the practice for continuing future research.

The study of soft system and creative ecology among the Indonesian craft makers enlightened the understanding of how the informal system operates in the craft practices, especially in Indonesia (section 4.5 and 6.1). The examination of stakeholders gave insights into several actions involved in the craft practices, which contributed to policymaking. The recommendations on appropriate technology and organisation provided a different approach for culturally significant products and processes (section 6.3). The combination of the hard system (the technology) and the soft system (the organisational structure) are compulsory to sustain the development of stitch-resist dyeing practice and reach community empowerment. The analysis of appropriate technology in this craft practice contributed to the development of knowledge about appropriate technology, which is mostly focused on the developing countries .

Apart from the above-stated contributions, this research provided comprehensive documentation of stitch-resist dyeing procedure, pattern, and practices among Indonesian craft makers. This documentation is acknowledged as an attempt to preserve the tacit knowledge of the technique that has been passed by generations. Having the technique records will help future studies and sustain the tradition in the long term.

7.4 Limitations of this research

Several limitations of the data collection, methodology and findings were encountered throughout this study. Following sections describe the four main constraints that occurred throughout the research process.

7.4.1 Limited records about the Indonesian stitch-resist dyeing patterns.

Limited literature of the Indonesian stitch-resist dyeing technique was the primary constraint at the beginning of this study. In this case, the literature was referred to the publication (i.e. books, journal papers), the Indonesian government statistical data, and the craft makers' records. The majority publications of Indonesian textiles are mainly focused on *batik* cloths or woven cloths. The statistical data of existing stitch-resist dyeing practices in Indonesia was not comprehensive since the practices can be under several

institutions in Indonesia (i.e. the Ministry of Co-operatives and SMEs, the Ministry of Trade, and the Creative Economy Agency). Additionally, the informal working nature of the Indonesian craft makers has neglected the importance of keeping the records of their previous patterns. Nevertheless, the study has succeeded to gather essential information from all resources despite the limitation.

7.4.2 Limitation on the dyeing experiments and pattern analysis

The experiment of correlation between the key factors with the resultant pattern has provided initial findings. A single straight line was selected as the test case with a variation of three experiments. The study experimented with cotton fabric and cotton thread, based on Indonesian practices. It would have been more comprehensive to experiment with different conditions, e.g. wavy or zigzag lines, a circle line, irregular stitch lengths and distance between stitches, and two colour combination. Furthermore, the examination can be applied in different types of materials, i.e. fabrics and threads. The exploration could give more insightful findings, generating a complete record of the stitch-resist dyeing techniques and patterns.

7.4.3 Limitation in creating prototyping

The laboratory experiment findings have given a concept to implement a tool to substitute the knotting mechanism. This study provides a fundamental principle on how the tool is functioned in section 6.3.1. However, the researcher's insufficient knowledge of mechanical engineering had given a limitation to build the prototype. The process of creating a prototype requires extensive engineering expertise to attain the requisite pressure and friction that can provide a high tightness level between the resist area. Furthermore, the examination of designing the prototype should include an analysis of selecting an appropriate material for the tools and the threads. The tool must be affordable with low environmental impacts. Several strategies can be adopted to follow a life cycle design (LCD) approach, such as minimize material consumption, select nontoxic and harmless materials, select renewable and biocompatible materials, and extend the lifespan of materials (Vezzoli, 2013). In short, the suggested tool is not only expected to solve the production issues of stitch-resist dyeing process but also to meet the design

for sustainable principle by encompassing environmental, economic, social and cultural aspects.

7.4.4 Limitation in conducting a pilot study of the revitalisation strategies implementation

The limited time available for the research makes it impossible to conduct a pilot study to compare suggested revitalisation strategies in a different location. Ideally, the pilot study needs to involve the Indonesian craft makers and other stakeholders who participated in the survey, which would require long and extensive research. However, the suggested revitalisation strategies from this study bridged the gap in the current knowledge, providing a framework on which future studies can be based.

7.5 Recommendations for future work

In this last chapter, the future work recommendations are discussed based on the constraints explained in the previous section (section 7.4). There are three main recommendations for future work, as follow:

1. Extensive experimentation on the correlation of the stitch-resit dyeing key factors and resultant patterns. Details of this recommendation have been provided, but not limited to the list mentioned in section 7.4.2.
2. Designing a prototype of a mechanical tool to enhance the resist mechanism. This recommendation for future study was referred to the limitation in creating a prototype explained in section 7.4.3. An opportunity to explore a new aesthetic of the Indonesian stitch-resist dyeing patterns can be obtained with the implementation of this tool (see an explanation in section 6.3.1).

3. A study of implementation and evaluation of revitalisation strategies: designing a co-operative stitch-resist dyeing facilities system for sustainable development through the collaboration of Indonesian craft makers. To have the maximum benefit from this study it is recommended to involve the quadruple helix stakeholders: the Indonesian government, the Indonesian craft makers, the civil society,

and academia. The incremental implementation could be applied based on the framework in section 6.4. This future study can overcome the limitation from this study explained in section 7.4.4.

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Appendix A
The survey instruments of Indonesian stitch-resist dyeing practices in three locations

A.1 Information sheet of the study

UNIVERSITY OF LEEDS

School of Design, University of Leeds

"Revitalisation of Stitch Resist Dyeing in Indonesian cloths"

Introduction
My name is Bintan Titisari. I am Indonesian and I am in my first year of PhD program at The School of Design, University of Leeds. My research is about stitch resist dyeing practice by craft-makers in Indonesia. For those of you who have experienced doing stitch resist dyeing, you are being invited to take part in a research project. There will be no risks by taking part of this research. Before you decide it is important for you to understand why the research is being done and what it will involve.

Research Aims
This research aim is to observe about current situation in Indonesian craft-makers who produce stitch resist dyeing in three main industry's areas, namely Jogjakarta (Central Java), Banjarmasin (South Kalimantan), and Palembang (South Sumatra). The main questions will be about production details (e.g procedure of each step, fabric and dye stuff that are regularly used), marketing (e.g current market and advertising of the products), and social situation presently. The research's results will be used to determine strategies to revitalise stitch resist dyeing among the community of Indonesian craft-makers using appropriate technology.

Research Methods
Methods that will be used in the research are questionnaire and more in-depth interviews for further clarify their thoughts and ideas. The participants will be asked to fill the questionnaire after they understand and agreed to participate in this research by filling a consent form. The interview will be conducted after the questionnaire with more comprehensive questions about production details, market, and social situations. Recording will be required during interview sessions and photograph will be taken to observe production details after interview sessions.

Participant's Right
Respondents will be reminded that they are under no obligation to take part, and that they can withdraw during or after the questionnaire and/or interview. Respondents have right to withdraw from the research by contacting the researcher until 1 (one) month after data collection.

Confidentiality and Anonymity
All of the answers will be used anonymity in PhD research and any personal information will be kept confidentially. Any information given was to be treated in strict confidence and the raw data would not be made available for any other persons or purposes.

Thank you for taking the time to read this information. For any questions or comments please contact the researcher.

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A.2 Consent form for survey

UNIVERSITY OF LEEDS

School of Design, University of Leeds

Following the information provided above, the participant acknowledges to understand the aims of the research and consent to take part in survey about:

"Revitalisation of Stitch Resist Dyeing in Indonesian cloths"

	Add your initials next to the statements you agree with
I confirm that I have read and understand the information sheet explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason before, until 1 (one) month after the survey	
I agree for the data collected from me to be used in PhD research of Bintan Titisari.	
I give permission for members of the research team to have access to my responses.	
I give permission to record my answers and to take photograph of production details for research purposes	
I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or report that result from the research	
I agree to take part in the above research project and will inform the lead researcher should my contact details change to research team.	

Name of participant	
Signature of participant	
Date	
Name of lead researcher	
Signature of lead researcher	
Date*	

*To be signed and dated in the presence of the participant

A.3 Questionnaire for survey

* **Instructions**: Please tick the appropriate box or fill in the blank.

1. **Gender?**

   ☐ Male ☐ Female

2. **What is your age range?**

   ☐ 18 – 25 ☐ 36 – 45 ☐ 56 and above
   ☐ 26 – 35 ☐ 46 – 55

3. **Which part of stitch resist dyeing production are you familiar with?**

   ☐ Fabric preparation ☐ Dyeing
   ☐ Design/pattern making ☐ Finishing
   ☐ Stitching ☐ Other: .....

4. **How long have you been learning this technique?**

   ☐ 0 – 1 year ☐ 6 – 10 years ☐ More than 15 years
   ☐ 2 – 5 years ☐ 11 – 15 years

5. **How did you learn about this technique?**

   ☐ School ☐ Friends/Relatives
   ☐ Course/training ☐ Other: .....
   ☐ Workplace

6. **How many cloths do you produce in one month?**

   ☐ 0 - 5 ☐ 11 - 20 ☐ 31 and above
   ☐ 6 - 10 ☐ 21 - 30

7. **Which type of fabric do you use? (you can choose more than one answer)**

   ☐ Cotton Primissima Kereta Kencana, width length 105cm
   ☐ Cotton Primissima Kupu Bendera, width length 105cm
   ☐ Cotton Primissima Gamelan, width length 105cm
   ☐ Cotton Primissima KK, width length 115cm
   ☐ Cotton Primissima FF, width length 115cm
   ☐ Cotton Primissima MK, width length 115cm
   ☐ Cotton Primissima 202, width length 115cm
   ☐ Cotton Prima KK-104, width length 115cm
   ☐ Cotton Prima KK-124, width length 115cm
   ☐ Cotton Prima KK-411, width length 115cm
   ☐ Cotton Primis KK-202, width length 115cm
   ☐ Cotton Primis KK-345, width length 105cm

☐ Cotton Primis KK-303, width length 105cm
☐ Cotton Primis KK-354, width length 115cm
☐ Cotton Voile KK-347, width length 115cm
☐ Cotton Prima KK-633, width length 115cm
☐ Cotton Voile KK-663, width length 115cm
☐ Other: ……

8. Could you explain why you choose that fabric? (you can choose more than one answer)

☐ Price
☐ Availability
☐ Consumer preferences
☐ Your quality preferences
☐ Your ability to use this fabric
☐ Other: ……

9. Where do you usually get the fabric? (you can choose more than one answer)

☐ Local Market, store name: ……
☐ Big retailer from Java, store name: ……
☐ Cooperative
☐ Other: ……

10. Could you explain how you prepare the fabric before stitch resist dyeing by choosing the box on each column below (you can choose more than one answer).

PHYSICAL TREATMENT	WATER TEMPERATURE	CHEMICAL ADDED	DURATION
☐Soak and leave still	☐Unheated water	☐None	☐1 hour
☐Soak and stir	☐Heated water	☐Sulphuric Acid (H_2SO_4)	☐2 hours
☐Other: ……	☐Boiling water	☐Hydrochloric Acid (HCl)	☐12 hours
	☐Other: ……	☐Turkish Red Oil	☐24 hours
		☐Soda Ash	☐36 hours
		☐Vegetable Oil	☐48 hours
		☐Other: ……	☐Other: ……

11. Could you explain the amount of fabrics, water and chemical (if used) employed in each of the processes that you use for preparing fabric (as described in question number 10)?

Fabrics : ..... metres
Water : ..... milliliters
Chemical : ..... milliliters

12. What type of thread do you use for the stitching process? (you can choose more than one answer)

- ☐ Cotton thread, specific brand/number: .....
- ☐ Polyester thread, specific brand/number: .....
- ☐ Mix thread (cotton-polyester), specific brand/number: .....
- ☐ Other: .....

13. How do you control stitch length?

- ☐ By sight
- ☐ By hand
- ☐ By sight and hand
- ☐ Other: .....

14. What type of dyestuff do you use for the dyeing process? (you can choose more than one answer)

- ☐ Direct dyes, specific type: .....
- ☐ VAT dyes, specific type: .....
- ☐ Reactive dyes, specific type: .....
- ☐ Disperse dyes, specific type: .....
- ☐ Sulphur dyes, specific type: .....
- ☐ Azoic dyes (naphthol), specific type: .....
- ☐ Natural dyes, specific type: .....
- ☐ Other: .....

15. Is there any finishing process after the dyeing process? (you can choose more than one answer)

- ☐ Soaking in chemical to maximize colour-fastness
- ☐ Ironing
- ☐ Other: .....

16. How do you sell your products? (you can choose more than one answer)

- ☐ Hand to hand
- ☐ On your own store
- ☐ On collective store
- ☐ On cooperative
- ☐ Using online platform (website, facebook, Instagram, etc)
- ☐ Others: .....

17. Who is your regular customers who buy your products so far? (you can choose more than one answer)

- ☐ Local residents for personal use
- ☐ Indonesian Company/organization
- ☐ Company/Organization from outside Indonesia
- ☐ Indonesian tourist
- ☐ International tourist (from other countries)
- ☐ Other: .....

18. Are there any obstacles encountered in carrying out the business using stitch resist dyeing technique? (you can choose more than one answer).

- ☐ The availability of raw materials (i.e fabrics, threads, dye-stuffs)
- ☐ Processing time of the technique
- ☐ Inconsistency of pattern results
- ☐ Lack of human resources (workers)
- ☐ High price of raw materials
- ☐ Low number of consumers
- ☐ None
- ☐ Other: .....

Thank you for your participation in this questionnaire.

Appendix B
The survey data

B.1 Participants list of the survey

Table B.1 List of participants on the Indonesian stitch-resist dyeing survey

Participant Code	Gender	Role	Enterprise/ Cooperative	Location	Specific area
P116001	Female	A	Cooperative	Yogyakarta	Soga (Tahunan)
P116002	Female	A/B	Enterprise	Yogyakarta	Soga (Tahunan)
P116003	Female	A/B	Enterprise	Yogyakarta	Soga (Tahunan)
P116004	Female	D	Enterprise	Yogyakarta	Soga (Tahunan)
P116005	Female	B/D	Cooperative	Yogyakarta	Soga (Tahunan)
P116006	Female	A	Cooperative	Yogyakarta	Soga (Tahunan)
P116007	Female	B	Cooperative	Yogyakarta	Soga (Tahunan)
P116008	Female	A/C	Cooperative	Yogyakarta	Soga (Tahunan)
P116009	Female	A	Cooperative	Yogyakarta	Sewon (Bantul)
P116010	Female	D	Cooperative	Yogyakarta	Sewon (Bantul)
P116011	Female	D	Cooperative	Yogyakarta	Sewon (Bantul)
P116012	Female	C	Cooperative	Yogyakarta	Sewon (Bantul)
P116013	Female	B	Cooperative	Yogyakarta	Sewon (Bantul)
P116014	Female	A	Cooperative	Yogyakarta	Patangpuluhan
P116015	Female	D	Cooperative	Yogyakarta	Patangpuluhan
P116016	Male	B	Cooperative	Yogyakarta	Patangpuluhan
P116017	Female	A/B	Enterprise	Yogyakarta	Pleret (Bantul)
P116018	Female	A	Enterprise	Yogyakarta	Sewon (Bantul)
P116019	Female	A	Cooperative	Yogyakarta	Berbah (Sleman)
P116020	Female	C	Enterprise	Yogyakarta	Berbah (Sleman)
P116021	Female	D	Enterprise	Yogyakarta	Berbah (Sleman)
P116022	Female	A/B	Enterprise	Yogyakarta	Berbah (Sleman)
P216023	Male	A/D	Enterprise	Palembang	Kel. Tuan Kentang
P216024	Male	A/D	Enterprise	Palembang	Kel. Tuan Kentang
P216025	Male	F	-	Palembang	Kel. Tuan Kentang
P216026	Male	A/D	Enterprise	Palembang	Kel. Tuan Kentang
P216027	Female	A/C	Enterprise	Palembang	Kel. Tuan Kentang
P216028	Male	A/D	Enterprise	Palembang	Kel. Tuan Kentang

Participant Code	Gender	Role	Enterprise/ Cooperative	Location	Specific area
P216029	Male	A/D	Enterprise	Palembang	Kel. Tuan Kentang
P216030	Male	A/D	Enterprise	Palembang	Kel. Tuan Kentang
P216031	Female	A/D	Enterprise	Palembang	Kel. Tuan Kentang
P216032	Female	A/D	Enterprise	Palembang	Kel. Tuan Kentang
P216033	Female	C	Enterprise	Palembang	Aiptu (Tuang Kentang)
P216034	Female	C	Enterprise	Palembang	Aiptu (Tuang Kentang)
P216035	Female	C	Enterprise	Palembang	Aiptu (Tuang Kentang)
P216036	Female	C	Enterprise	Palembang	Aiptu (Tuang Kentang)
P216037	Female	C	Enterprise	Palembang	Aiptu (Tuang Kentang)
P216038	Male	A/D	Enterprise	Palembang	Kel. Tuan Kentang
P316039	Male	A	Enterprise	Banjarmasin	A. Yani KM 7.6
P316040	Female	C	Enterprise	Banjarmasin	A. Yani KM 7.6
P316041	Female	A/D	Enterprise	Banjarmasin	A. Yani KM 7.5
P316042	Male	A/D	Enterprise	Banjarmasin	A. Yani KM 7.5
P316043	Female	A/C	Enterprise	Banjarmasin	A. Yani KM 7.5
P316044	Male	F	-	Banjarmasin	-
P316045	Male	A	Enterprise	Banjarmasin	Seberang Mesjid
P316046	Female	A/C	Enterprise	Banjarmasin	Seberang Mesjid
P316047	Female	B	Enterprise	Banjarmasin	Seberang Mesjid
P316048	Female	C	Enterprise	Banjarmasin	Seberang Mesjid
P316049	Male	D	Enterprise	Banjarmasin	Seberang Mesjid
P316050	Male	A/B	Enterprise	Banjarmasin	-
P316051	Male	A/B	Enterprise	Banjarmasin	Sungai Jingah
P316052	Female	A	Enterprise	Banjarmasin	Sungai Jingah
P316053	Female	C	Enterprise	Banjarmasin	Sungai Jingah
P316054	Male	B	Enterprise	Banjarmasin	Sungai Jingah
P316055	Female	A/F	Enterprise	Banjarmasin	Banjarbaru
P316056	Female	A/B/ F	Enterprise	Banjarmasin	Banjarbaru
P316057	Female	A/D	Enterprise	Banjarmasin	Pemurus Raya (A.Yani km 4)
P316058	Female	A	Enterprise	Banjarmasin	Manarap
P317059	Male	A/D/ F	Enterprise	Banjarmasin	Mulawarman
P317060	Female	C	Enterprise	Banjarmasin	Kamp. Melayu
P317061	Female	B/F	Enterprise	Banjarmasin	Seberang Mesjid
P317062	Female	C	Enterprise	Banjarmasin	Seberang Mesjid
P317063	Female	C	Enterprise	Banjarmasin	Seberang Mesjid
P317064	Female	C	Enterprise	Banjarmasin	Seberang Mesjid
P317065	Female	F	-	Banjarmasin	Kel. Sungai Miai

Participant Code	Gender	Role	Enterprise/ Cooperative	Location	Specific area
P317066	Female	C	Enterprise	Banjarmasin	Pekapuran Raya
P317067	Female	C	Enterprise	Banjarmasin	Pekapuran Raya
P317068	Female	C	Enterprise	Banjarmasin	Pekapuran Raya
P317069	Female	C/E	Enterprise	Banjarmasin	Pekapuran Raya
P317070	Female	A	Enterprise	Banjarmasin	Pekapuran Raya
P317071	Female	F	-	Banjarmasin	Kel. Sungai Miai
P317072	Male	F	-	Banjarmasin	Mulawarman
P317073	Male	B	Enterprise	Banjarmasin	A. Yani Km 18
P317074	Male	A/B	Enterprise	Banjarmasin	Seberang Mesjid
P317075	Male	A/B	Enterprise	Banjarmasin	Seberang Mesjid
P317076	Female	F	-	Banjarmasin	Pemurus Raya (A.Yani km 4)
P317077	Female	F	-	Banjarmasin	-

Description of role:

A: Enterprise Owner
B: Fabric cutter
C: Designer
D: Drafter
E: Stitcher
F: Dyer
G: Distributor
H: Unknotter
I: Finishing controller
J: Expertise/historian/community

B.2 Sample of interview transcriptions from the survey

Interviewer (A) : Bintan Titisari

Interviewee (B) : P316054 (46 years old)

Date of Interview : 19 November 2016

Start time of Interview : 10.00 am

End of Interview : 10.45 am

Location of Interview : Banjarmasin

A: Which part of stitch-resist dyeing production are you familiar with?

B: Now I only do the colouring part however I could do the stitching part too. My husband is making the design while other craft-makers in my neighbourhood are undertaking the running stitch production.

A: How long have you been learning this technique?

B: I have learned for 30 years but started my own business for nine years.

A: How did you learn about this technique?

B: Actually, it was my brother that introduced me to this business. I have been watching him doing stitch-resist dyeing production for 30 years ago, and then I decided to make my own production. After I produced my own clothes and

marketed my products, the Government Tourism Office offered me to join their training in colouring technique.

A: Tell me the story when you decided to start your own business

B: I started my first debut on a workshop held by the local government that provide young people to learn how to make *sasirangan* cloth. My work was very nice thus teachers at the local school start to order *sasirangan* cloth from me. I had started my business by myself for four years when my husband decided to help me in making the design and colouring part.

A: How many workers do you employ currently?

B: I have four workers to help us in colouring part; two are permanent workers, and the other two are helping us when we have many orders. My husband and I will only do a customised order for an important person.

A: Where did your husband learn to make a design?

B: He learnt it by himself with trial and error method after he finished his work.

A: What is your husband affiliation?

B: He is working on Disperindag (the Ministry of Industry and Trade) in Banjar Baru District. That is why he only has less time to do *sasirangan* works. He usually goes back from office around 4 pm and gets some rest before start drawing *sasirangan*'s design at 7 pm after night pray. Sometimes he will finish at 1 am if we have many orders.

A: How old is your husband now?

B: He is 50 years old

A: Let us talk about your employee again, so you have four employees for the colouring part. What about stitching process, how many workers do you employ for that part?

B: There are 15 women who help me in stitching part. Most of them are living around my neighbour and will do the works at their house.

A: How many cloths do you produce in one month?

B: Roughly around 500-700 cloths in a month.

A: Which type of fabric do you use?

B: Mostly cotton with three types of cotton namely Cotton Japan that usually called sateen cotton, cotton *Primissima*, cotton Polissima. We also use silk with two types: ATBM Silk, Chinese silk, and half-silk.

A: What is the different between cotton *Primissima* and cotton Polissima?

B: Cotton *Primissima* is more dense compare to cotton polissima. I can say the quality of cotton *primissima* is better that cotton polissima.

A: Where do you usually get the fabric?

B: In Banjarmasin. There are two local distributors for the fabric. I used to order it from Pekalongan back then, but they did not quiet deliver the right fabric, so I had to send it back to them. It cost me more. Now I can just go to the local distributor and pick the fabric by myself.

A: Could you give me the name of the store in Pekalongan and Banjarmasin?

B: German store is the one in Pekalongan, and Mulia store is the one in Banjarmasin. The other thing that I like from Mulia store is they have a good selection of fabrics, such silk with flower jacquard on it.

A: Could you explain why you choose that fabric that you mentioned above?

B: Those fabrics that I chose are easier to colour, and I also chose it based on my customer's preferences.

A: Could you explain how you prepare the fabric before stitch-resist dyeing?

B: First I cut the fabric, then soak it in the water. Actually, there is another way to do it: Cut - draw the design - stitch and knot – soak, but I prefer to soak it first with unheated water and soap or TRO before I make the design and stitch it. For ten pieces of fabrics, I need one big bowl of water and one tablespoon of soap. It takes about one to one and a half hour to soak the fabric. I rarely use natural colouring because it is hard to find though I personally prefer the chemical ones. However, the market for the natural dye is actually very promising, but the process takes very long time since we need to dye it ten times only to get black colour. I mostly used chemical paste colouring for my technique.

A: Which type of chemical dye paste that you usually use?

B: I use naphthol and indantrin dye paste.

A: Is there any finishing process that you usually apply after the colouring part?

B: Yes, I soak it in fixanol liquid to keep the colour from fading. After that, I dry the cloth and iron it.

A: Where do you buy the chemical dye paste and fixanol liquid? Moreover, could you explain about fixanol?

B: I usually buy those things at the same store where I buy the fabrics, so it is like one stop shopping. They provide everything there. Fixanol looks like water but a little bit thicker. I usually use fixanol for the cold dyeing process.

A: What type of thread do you use for the stitching process?

B: I usually use LEPIS (Levis brand) thread that usually used to sew jeans pants.

A: How do you control stitch length?

B: Actually I do not have any exact precise measurement, as long as it small enough. I control it just by sight (and then she shows the example of small stitch).

A: How do you sell your products?

B: Usually it is word of mouth. I have my own showroom and customer come to my showroom. I have my Instagram to promote my products, but I rarely update it. I use Instagram to show the examples of my works, and people tend to order based on the examples. Government Tourism Office helped me to market my product as well, they usually bring the local and international tourist to my showroom.

A: Who are your regular customers who buy your products so far?

B: Mostly from Indonesian organisations, and tourists as I mentioned above, such as Korea.

A: Are there any obstacles encountered in carrying out the business using stitch-resist dyeing technique?

B: Mostly is the fabric availability itself. Sometimes it took me about six months to get the fabric that I desired. There is also another problem such as a bit of torn fabric post-production, but not that much, only occurred perhaps 1-2 out of 30 in my production. Other than that, if the stitch is loose, the pattern will not come out. There are no major obstacles for me.

A: Have you ever got any problems to find the workers?

B: No, not at all. We have plenty of workers around here, either in stitching part or colouring part. Some of the makers are doing the colour process for other *sasirangan* enterprise, such as Sahabat *sasirangan.* There is 22 stitch-resist dyeing makers in this area. I heard that government is going to launch this area as *sasirangan* village for Banjar District.

Appendix C
Generated Data from MATLAB

C.1 MATLAB Code

```
clear

close all
I = imread('crop_527.tif');
I = imresize(I,0.1);
% Ismall = imresize(I,0.1);
s = size(I);
I = reshape(I,s(1)*s(2),3);
I = double(I);
XYZ = 100*srgb2xyz(I);
LAB = xyz2lab(XYZ,'d65_64');
comps = 2;

[IDX,C] = kmeans(I,comps,'Start','uniform','EmptyAction','singleton');
index1=0;
index2=0;
for i=1:s(1)*s(2)
   if IDX(i)==1
      PI(i,:) = [255 255 0];
      index1=index1+1;
      L1(index1) = LAB(i,1);
   else
      PI(i,:) = [255 0 0];
      index2=index2+1;
      L2(index2) = LAB(i,1);
   end
end
I = reshape(uint8(I),s(1),s(2),3);
I2 = reshape(uint8(PI),s(1),s(2),3);
figure
subplot(2,1,1)
imshow(I);
subplot(2,1,2)
imshow(I2)
```

```
dims = size(C);
for i=1:dims(1)
  num(i) = sum(IDX==i);
end
C = [C num' [1;2]];
C = sortrows(C,-4)
index = C(2,5);
if (index==1)
   L = L1;
else
   L = L2;
end
figure; histogram(L)
xlabel('Lightness')
ylabel('Pixel')

axis([0 90 0 300])
S = std(L)
val1 = [min(L1) mean(L1) max(L1)]
val2 = [min(L2) mean(L2) max(L2)]
num = length(L)
```

C.2 MATLAB Data

Table C.1 Data generated from the MATLAB programme

Sample number	Shades	Stitch length	Tightness level	Sdev	Min of white lightness value	Mean of white lightness value	Max of white lightness value	Number of blue pixels	Number of white pixels
301	1%	3 mm	Low	3.89	40.38	44.48	62.02	16979	589
302	1%	3 mm	Low	5.55	43.29	50.57	67.65	17181	387
303	1%	3 mm	Low	3.73	39.33	43.84	57.14	17020	548
304	1%	3 mm	Med	5.03	42.83	49.97	64.20	16879	689
305	1%	3 mm	Med	5.93	46.03	54.62	70.23	16926	642
306	1%	3 mm	Med	4.98	44.06	50.58	66.17	16957	611
307	1%	3 mm	High	6.66	50.52	62.90	76.12	16652	916
308	1%	3 mm	High	5.77	46.60	55.73	70.33	16897	671
309	1%	3 mm	High	6.12	47.28	57.11	74.36	16886	682
310	2%	3 mm	Low	5.54	28.13	34.37	55.07	17157	411

Sample number	Shades	Stitch length	Tightness level	Sdev	Min of white lightness value	Mean of white lightness value	Max of white lightness value	Number of blue pixels	Number of white pixels
311	2%	3 mm	Low	6.54	29.16	36.12	54.04	17359	209
312	2%	3 mm	Low	5.68	28.00	34.47	51.62	17408	160
313	2%	3 mm	Med	4.95	28.12	34.10	54.04	17090	478
314	2%	3 mm	Med	7.23	31.72	39.78	59.83	17161	407
315	2%	3 mm	Med	6.48	29.42	36.86	57.01	17204	364
316	2%	3 mm	High	7.11	32.69	43.32	61.85	17087	481
317	2%	3 mm	High	7.23	31.90	41.35	61.82	17119	449
318	2%	3 mm	High	8.27	36.00	48.23	72.00	17011	557
319	3%	3 mm	Low	4.94	19.81	26.49	44.94	17107	461
320	3%	3 mm	Low	8.80	27.68	41.20	66.76	17060	508
321	3%	3 mm	Low	7.25	22.37	30.79	58.93	17130	438
322	3%	3 mm	Med	8.49	26.69	39.29	61.20	17119	449
323	3%	3 mm	Med	9.49	28.63	42.56	67.45	17088	480
324	3%	3 mm	Med	6.00	20.19	26.84	49.28	17223	345
325	3%	3 mm	High	10.83	30.58	46.69	74.25	16961	607
326	3%	3 mm	High	9.59	24.70	35.34	61.05	17286	282
327	3%	3 mm	High	6.74	21.60	30.49	49.36	17140	428
501	1%	5 mm	Low	3.28	41.67	45.53	58.82	16486	1082
502	1%	5 mm	Low	2.73	38.84	41.90	57.07	16395	1173
503	1%	5 mm	Low	4.26	42.06	47.38	61.63	16783	785
504	1%	5 mm	Med	4.83	42.89	49.66	65.20	16905	663
505	1%	5 mm	Med	5.61	42.93	49.90	66.32	16942	626
506	1%	5 mm	Med	5.31	43.25	51.11	66.56	16800	768
507	1%	5 mm	High	6.52	44.50	53.78	70.81	16862	706
508	1%	5 mm	High	5.85	44.77	52.49	68.50	16887	681
509	1%	5 mm	High	6.16	44.19	52.85	69.05	16973	595
510	2%	5 mm	Low	2.95	24.57	27.18	46.82	16533	1035
511	2%	5 mm	Low	5.88	29.22	36.81	54.64	17101	467
512	2%	5 mm	Low	5.10	28.36	34.14	52.70	16962	606
513	2%	5 mm	Med	4.56	27.67	32.90	53.97	16956	612
514	2%	5 mm	Med	6.98	30.46	38.46	60.14	17034	534
515	2%	5 mm	Med	6.15	27.19	33.40	54.53	17214	354
516	2%	5 mm	High	8.58	35.04	47.45	66.25	16970	598
517	2%	5 mm	High	7.38	31.46	40.07	62.54	17077	491
518	2%	5 mm	High	7.95	34.40	45.68	65.26	16991	577
519	3%	5 mm	Low	2.01	16.09	18.51	27.16	16708	860
520	3%	5 mm	Low	2.61	16.55	19.16	38.55	16695	873
521	3%	5 mm	Low	4.53	17.41	21.08	46.36	17062	506
522	3%	5 mm	Med	7.99	25.08	34.84	57.49	17124	444
523	3%	5 mm	Med	5.92	21.53	29.23	48.12	17145	423

Sample number	Shades	Stitch length	Tightness level	Sdev	Min of white lightness value	Mean of white lightness value	Max of white lightness value	Number of blue pixels	Number of white pixels
524	3%	5 mm	Med	9.71	29.65	43.19	66.25	17068	500
525	3%	5 mm	High	9.01	27.24	39.94	66.32	16992	576
526	3%	5 mm	High	7.05	23.92	33.86	54.21	16987	581
527	3%	5 mm	High	7.40	22.87	32.11	54.18	17180	388

Appendix D
Instruments for the visual perception study

D.1 Information sheet of the study

UNIVERSITY OF LEEDS
School of Design, University of Leeds

INFORMATION SHEET
"The study of visual perception of stitch-resist dyeing patterns"

You are being invited to take part in a research project (ethics reference: LTDESN-108). Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

This study conducted by a researcher at the School of Design, University of Leeds, in conjunction with a PhD research, title: Revitalisation of stitch-resist dyeing on Indonesian cloth. This study aims to examine the visual perception of stitch-resist dyeing patterns in terms of pattern clarity and preferences. You will be asked to identify and discuss some stitch-resist dyeing fabric samples. You are not required to know the stitch-resist dyeing technique, but any design background (especially textile design) is preferable.

The participation for this research is entirely voluntary. If you decide to take part, you will be asked to sign a consent form. You will be given the information sheet and a copy of consent form to keep. All the information that we collect about you during the study will be kept strictly confidential. You will not be able to be identified in any reports or publications. All data will be destroyed two years after the data collection.

The study will take place only one time and use approximately **60 minutes** of your time in the Colour Laboratory, School of Design. At the beginning of the study, the researcher will ask participants to fill a short participant profile sheet. Then the researcher will give a brief introduction about the technique.
The study has two parts:

1) Part 1: Examine the pattern clarity of each sample (approx. 30 minutes)
2) Part 2: Rank your preference from a group of samples (approx. 30 minutes)

You will see the samples under the light box using a setting on the D65 light source (artificial daylight). At the end of each part, the researcher will ask some questions to understand the reason behind every selection. The researcher will do an audio recording during the interview for transcription purposes and take photographs only for documenting the answers on part two.

There are no associated risks with this study. However, if any issues arise, please inform the researcher immediately. Participants also have the right to withdraw within two weeks of the test being conducted without being prejudice and without providing a reason. In the event of withdrawal, all data already provided will be deleted.

We want to **thank you very much** for taking the time to read this information. Your collaboration is very much appreciated. For any questions or comments, please contact the researcher.

Research Contact Details:
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+44 754 1040 518
School of Design, University of Leeds, Leeds, LS2 9JT
Supervisors:
Dr Muriel Rigout, Prof Tom Cassidy, Dr Alice Dallabona

D.2 Consent form for the study

UNIVERSITY OF LEEDS

School of Design, University of Leeds

CONSENT FORM

Consent to take part in **"The study of visual perception of stitch-resist dyeing patterns"**	Add your initials next to the statements you agree with
I confirm that I have read and understood the information sheet explaining the above research project, and I have had the opportunity to ask questions about the project.	
I understand that my participation is voluntary and that I am free to withdraw within two weeks and without there being any negative consequences. In addition, should I not wish to answer any particular question(s), I am free to decline. Please contact: **Bintan Titisari (07541040518)**	
I understand and agree that my interview will be recorded for transcription purposes, and some photographs will be taken for documenting the answers.	
I understand that my name will not be linked with the research materials, and I will not be identified in the report that result from the research.	
I understand that members of the research team may have access to my anonymised responses.	
I understand and agree that the data collected from me may be stored for two years after the data collection	
I agree to take part in the above research project and will inform the researcher should my contact details change.	

Name of participant	
Signature of participant	
Date	
Name of researcher	
Signature of researcher	
Date*	

**To be signed and dated in the presence of the participant*

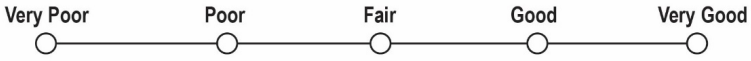
D.3 Participant's profile sheet

PARTICIPANT PROFILE SHEET (ID:)

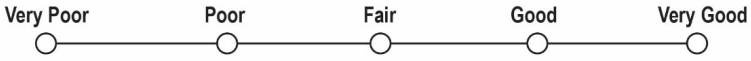
*** Instructions**: Please tick the appropriate box or fill in the blank.

1. To which gender do you most identify?
   - ☐ Female
   - ☐ Male
   - ☐ Other, please specify: …….
   - ☐ Prefer not to answer
2. What is your age range?
   - ☐ Under 20
   - ☐ 20 to 29
   - ☐ 30 to 39
   - ☐ 40 to 49
   - ☐ 50 to 59
   - ☐ Above 60
3. Which of the following best describe your occupation?
   - ☐ Student
   - ☐ Postgraduate student
   - ☐ Academic
   - ☐ Professional non-academic
   - ☐ Self employed
   - ☐ Other: ……..
4. What is your subject area?
   - ☐ Design
   - ☐ Non-Design

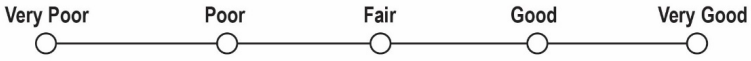
   If your subject area is design, could you specify the specific area:
   - ☐ Textile design
   - ☐ Fashion design
   - ☐ Graphic design
   - ☐ Industrial Product design
   - ☐ Other, please specify: ……..
5. Does your culture have any relations with any of these cloths (*jumputan*, *tritik*, *pelangi*, *sasirangan*, *batik*)?
   - ☐ Yes
   - ☐ No
6. How would you describe your knowledge about stitch-resist dyeing technique?

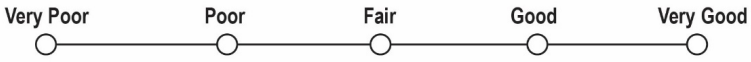
7. How would you describe your knowledge about tie-dye technique?

8. How would you describe your knowledge about *batik* technique?

9. How would you describe your knowledge about *shibori* technique?

D.4 Answers sheet

ANSWER SHEET

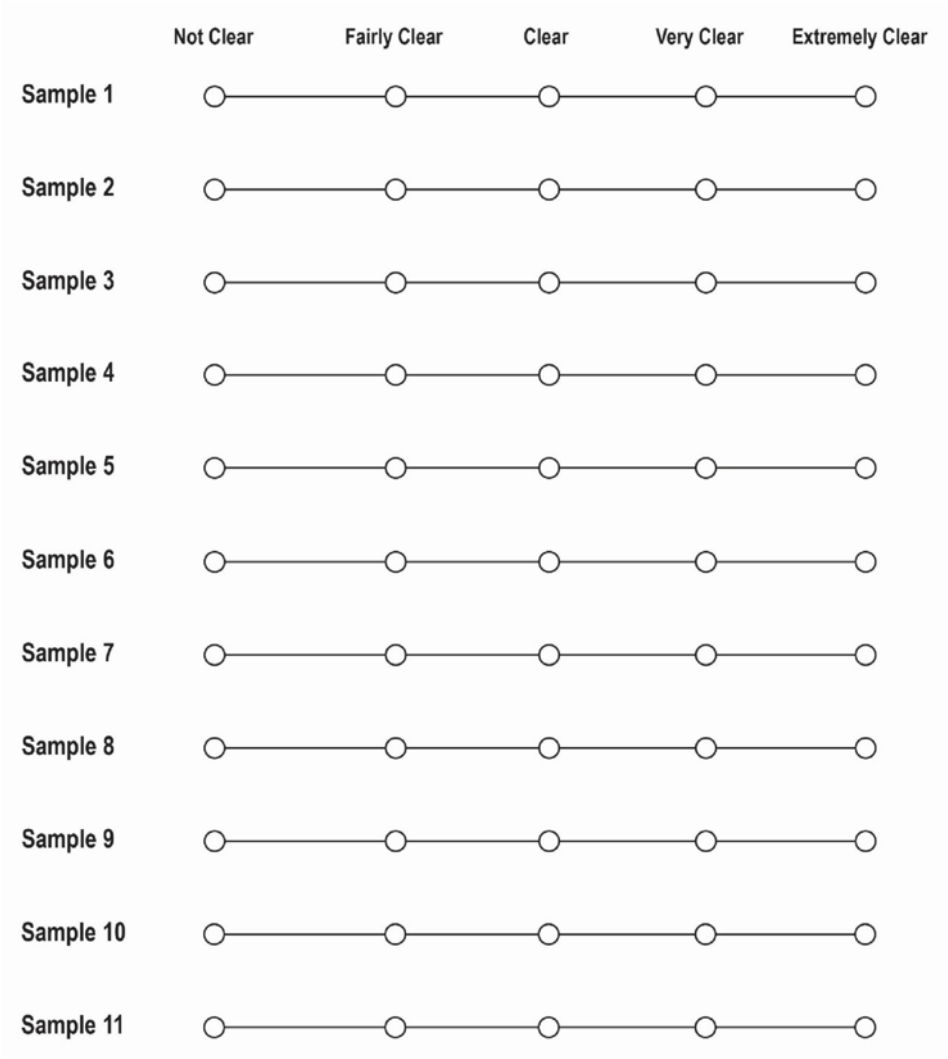
The study of visual perception of stitch-resist dyeing patterns

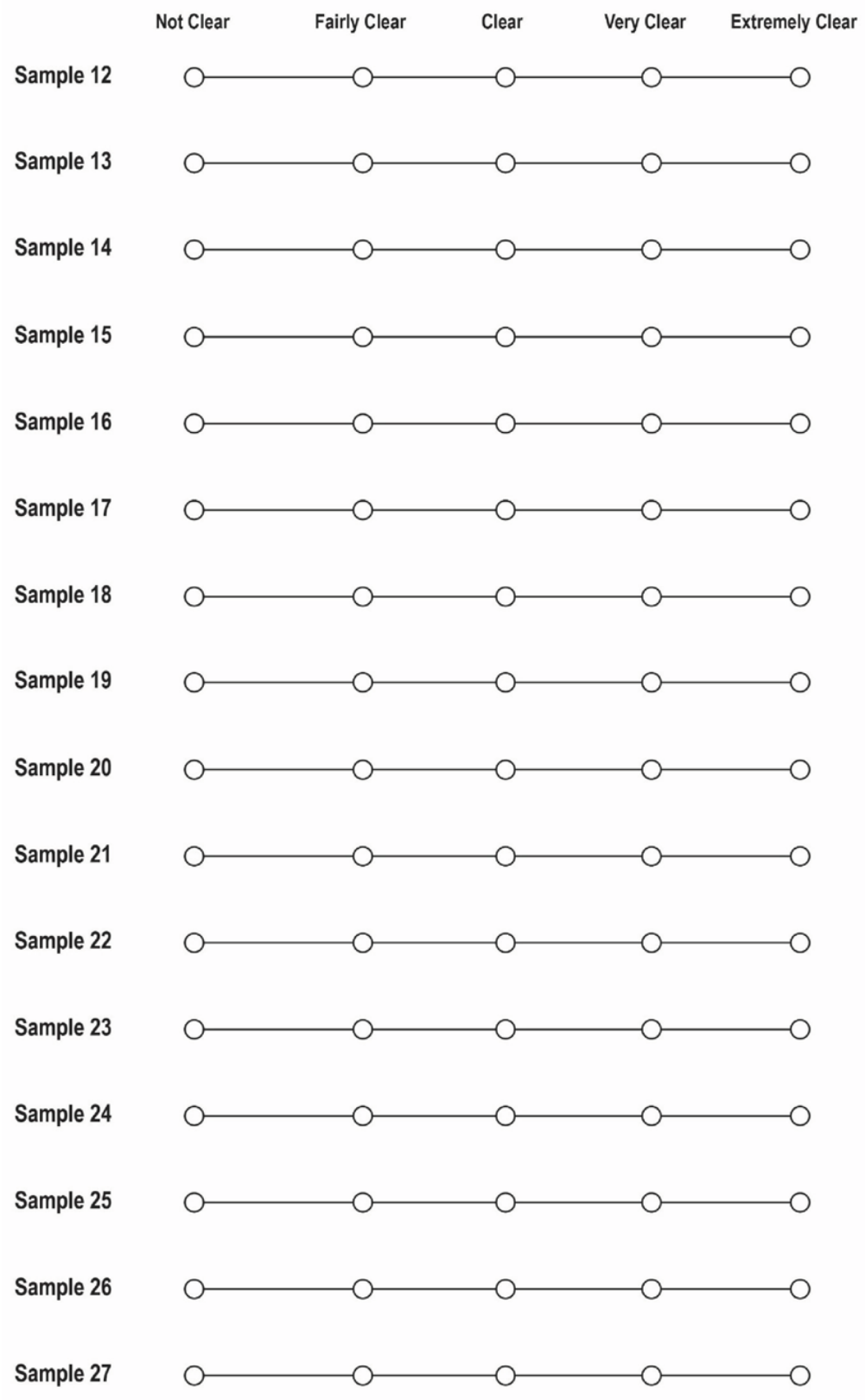
Date : .....

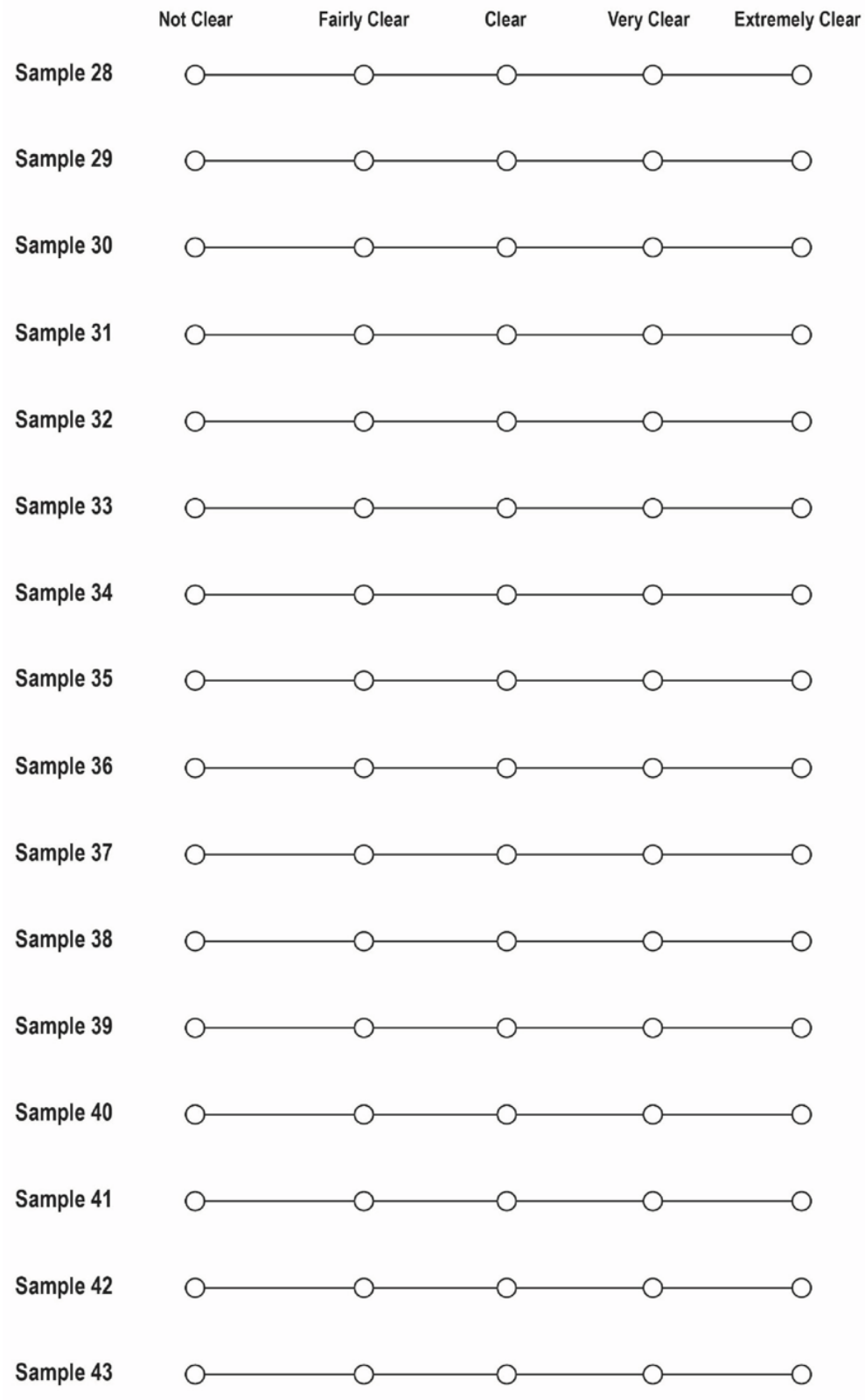
Participant ID : ..... (filled by the researcher)

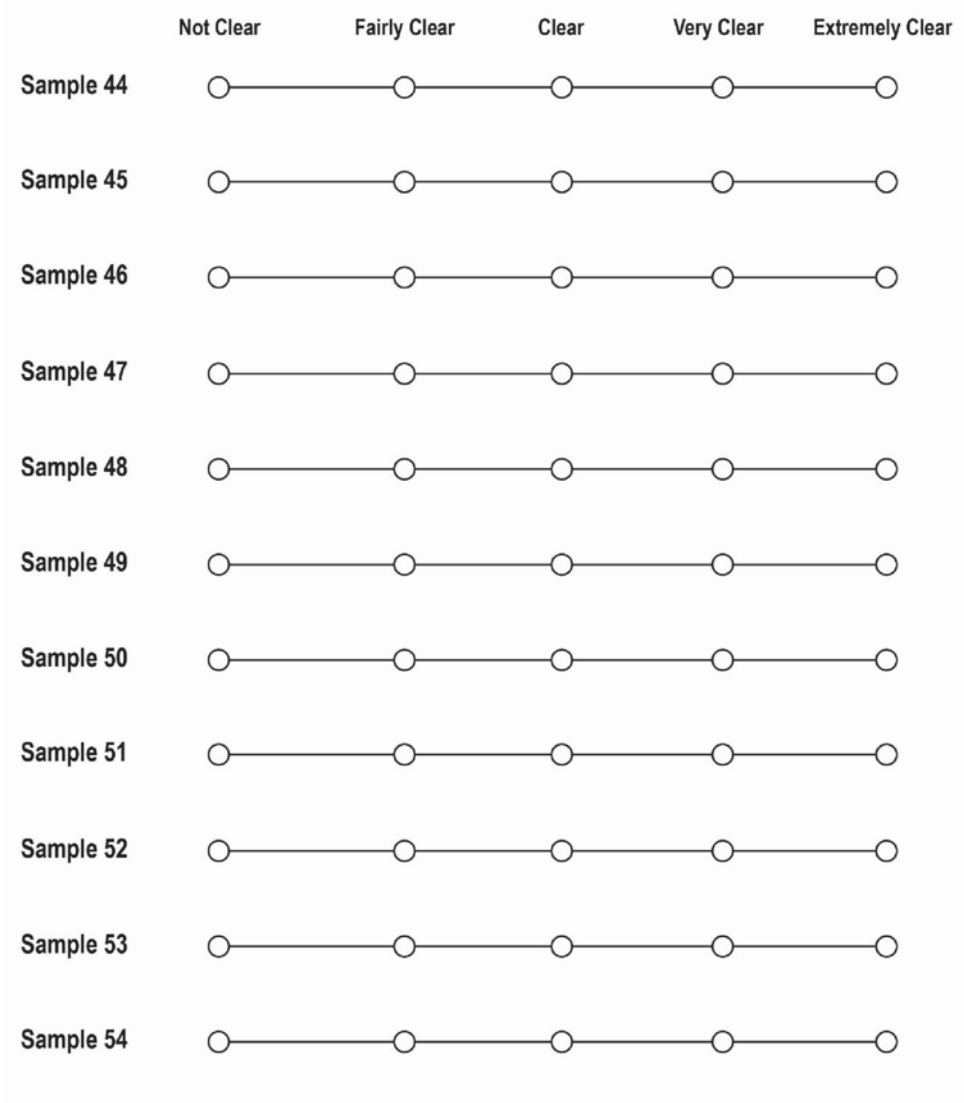
Part 1: Examine the pattern clarity

The researcher will set a sample under the light box. Please examine each sample given, then indicate the clarity of each sample by crossing the appropriate circle. How do you perceive the clarity of these sample patterns?




Not Clear
Fairly Clear
Clear
Very Clear
Extremely Clear
Sample 12
Sample 13
Sample 14
Sample 15
Sample 16
Sample 17
Sample 18
Sample 19
Sample 20
Sample 21
Sample 22
Sample 23
Sample 24
Sample 25
Sample 26
Sample 27


Not Clear
Fairly Clear
Clear
Very Clear
Extremely Clear
Sample 28
Sample 29
Sample 30
Sample 31
Sample 32
Sample 33
Sample 34
Sample 35
Sample 36
Sample 37
Sample 38
Sample 39
Sample 40
Sample 41
Sample 42
Sample 43



After examining all the samples, would you please answer some questions below?

1. How do you define the pattern clarity of the stitch-resist dyeing cloths?
2. What factors that you consider when examining the pattern clarity?

Part 2: Rank the pattern preferences

The researcher will give a group of samples. Participants will be asked to examine the samples under the light box. Please rank the samples from less preferable to most preferable. Once you are happy with the order, please put the sample number in the following table.

1. Could you explain how do you decide the order based on your preference?
2. What factors influence your decision on pattern preferences?

Group number	**Preferences rank of sample number (less preferable to most preferable)**						
Group 1							
Group 2							
Group 3							
Group 4							
Group 5							
Group 6							

Thank you very much for taking part in this study.
Your collaboration is very much appreciated.

D.5 Group description on the visual perception study part 2

Table D.1 Six groups on the visual perception study part 2.

Group description	Sample Number	Experiment number	Shade	Tightness Level
Group 1 (1% depth of shade)	4	crop_307	1%	High
	6	crop_507a	1%	High
	8	crop_305	1%	Medium
	10	crop_504a	1%	Medium
	12	crop_301	1%	Low
	14	crop_503a	1%	Low
Group 2 (2% depth of shade)	22	crop_318	2%	High
	24	crop_516	2%	High
	26	crop_314	2%	Medium
	28	crop_514	2%	Medium
	30	crop_311	2%	Low
	32	crop_512	2%	Low
Group 3 (3% depth of shade)	40	crop_325	3%	High
	42	crop_525	3%	High
	44	crop_322	3%	Medium
	46	crop_523	3%	Medium
	48	crop_321	3%	Low
	50	crop_519	3%	Low
Group 4 (High tightness level)	4	crop_307	1%	High
	6	crop_507a	1%	High
	22	crop_318	2%	High
	24	crop_516	2%	High
	40	crop_325	3%	High
	42	crop_525	3%	High
Group 5 (Medium tightness level)	8	crop_305	1%	Medium
	10	crop_504a	1%	Medium
	26	crop_314	2%	Medium
	28	crop_514	2%	Medium
	44	crop_322	3%	Medium
	46	crop_523	3%	Medium
Group 6 (Low tightness level)	12	crop_301	1%	Low
	14	crop_503a	1%	Low
	30	crop_311	2%	Low
	32	crop_512	2%	Low
	48	crop_321	3%	Low
	50	crop_519	3%	Low

Appendix E
The visual perception study data

E.1 Participants' profiles of the visual perception study

The information (question and answers) provided in Table E.1 are referred to the participant's profile sheet in Appendix D3.

Table E.1 List of participants for the visual perception study

Participant code	Q1	Q2	Q3	Q4		Q5	Q6	Q7	Q8	Q9
VS001	F	4	2	Design	4	No	1	4	3	1
VS002	F	2	1	Design	5	Yes	2	3	3	2
VS003	F	2	1	Design	5	Yes	3	3	4	3
VS004	F	2	5	Design	5	Yes	3	3	3	1
VS005	F	3	2	Non-Design	-	Yes	3	3	3	1
VS006	F	3	2	Design	1	No	5	5	3	4
VS007	F	2	2	Design	1	No	2	2	2	2
VS008	F	3	2	Non-Design	-	Yes	3	3	4	1
VS009	F	3	5	Non-Design	-	Yes	3	3	3	2
VS010	F	3	2	Design	1	Yes	1	3	4	1
VS011	F	2	2	Design	1	No	4	4	3	1
VS012	F	2	2	Design	1	No	3	4	3	2
VS013*	F	3	2	Design	1	No	3	4	3	1
VS014	F	2	1	Design	2	Yes	2	3	3	3
VS015	F	3	2	Design	5	No	2	2	2	2
VS016	F	2	2	Design	1	No	3	4	3	3
VS017	M	3	2	Non-Design	-	Yes	1	1	4	1

Participant code	Q1	Q2	Q3	Q4		Q5	Q6	Q7	Q8	Q9
VS018*	F	3	2	Design	2	Yes	3	2	3	2
VS019	M	2	2	Non-Design	-	Yes	2	2	4	1
VS020	M	3	2	Non-Design	-	Yes	3	3	4	1
VS021	F	3	2	Design	2	No	3	3	2	1
VS022	F	2	3	Design	1	Yes	4	4	4	3

Description:

* The participant's answer was not used for the study because there were language difficulties from the interviewees in understanding the question and also from the interviewer in interpreting their answers.

E.2 Sample of interview transcriptions from visual perception study

Interviewer (A) : Bintan Titisari

Interviewee (B) : VS017

Date of Interview : 19 September 2019

Start time of Interview : 10.00 am

End of Interview : 11.30 am

Location of Interview : The colour laboratory, School of Design, University of Leeds

Part 1

A: After you see the whole 54 samples, how do you define the pattern clarity from this technique?

B: For me, I look the pattern clarity based on contrast between the white area and the blue background, and also based on the whole line. I saw some lines are very bright in the beginning and start fading out towards the end. If I see the line that is bright until the end, I will define it as extremely clear. If I see the start is clear and then it starts gradually fading but I still can see it, I will put it as very clear. But if I cannot see the pattern at all...well, I mean if the pattern is almost in the same colour with the background colour, I will put it as not clear.

A: Ok. How do you define the contrast value?

B: I think it the fabric has a very dark blue and the pattern appears very bright, it will have a strong contrast. If the background is the ocean blue, I mean the light blue one, and the pattern is blue, I think the pattern will have less clear.

A: Do you consider another factor?

B: I think the dots (or pattern) is also matter. If it's too small, I will find it difficult to see.

A: Ah, do you mean the size?

B: Yes, the size of each dot.

A: Is that everything?

B: I think so. I mentioned about contrast, the dots' size, and also the consistency of the white pattern.

A: Ok, thank you. Let's move to the second part.

Part 2

A: Ok, now we move to the second part which still uses the same samples, but I already put it into groups. For the second part the objective is your preference, so it has nothing to do with the clarity although if you think clarity is part of the important factors, then it's ok. Each group has 6 samples and then I would like you to rank these samples in the order you prefer. The far right is the one you prefer the most, the left is the least preferred. So, you can move the cards until you the preferred order.

Group 1 (12-14-8-6-10-4)

A: Can you explain how and why you decide this order?

B: I like number 4 because the pattern is very clear. So, I think I can see the pattern clearly if I wear a shirt with this pattern. If I have pattern number 12, I don't think I can see it. I was quite confused between number 10 and 6, because number 6 has better clarity compare to number 10. But I think number 6 has inconsistency pattern, where it is bright in the beginning and then it starts fading away. Meanwhile, number 10 is more consistent in vague pattern throughout the line. I was thinking that maybe people were in a rush when creating the pattern in number 6, while number 10 seems longer in process. I also think, maybe that's how the pattern should be. Although, number 12 is too dim.

A: What about number 8 and 14?

B: I cannot see a pattern in number 14, not very clear. I think if I wear a *batik*, I will see if the pattern is striking or not. Number 8 is also not consistent; it's fading at the end part.

A: So, can I say that you decide from the pattern clarity first and then looking at their consistency?

B: yes, exactly.

A: Ok, thank you. Let's move to group 2.

Group 2 (30-26-32-28-24-22)

A: Ok, what about this group? You mentioned that you were having a dilemma in this group. Why do you think that way?

B: First of all, none of these samples are consistent in terms of their dots or circles. Number 30 is not clear. I questioned myself, if it actually has a motif or not. Number 26 and 32 are slightly clearer than number 30 but I still cannot see the pattern. Number 22 has relatively a stable or consistent pattern, there are some dots that are slightly bigger than other. I can see that because it's only one line, but I think, you won't see it if the clothes have more than one line.

A: Ah ok. I saw that you kept changing number 24 and 28 positions. Can you explain to me the reason?

B: I think both 28 and 24 are quite similar. Number 28 is clearer than 24, but it's fading at the end part. While number 24 is relatively more constant. I prefer number 24. I also see that circles in number 24 are small in the beginning, then they are slightly bigger in the middle, and then they are back to small size again. It looks like an oval. I think number 22 has more consistent shape.

A: Ok, thank you. Let's move to group 3.

Group 3 (50-42-40-48-44-46)

A: Ok, tell me about this order.

B: Ok, I will start from number 46. I think number 46 is very cool, I really like it. It's almost perfect for me. The colour contrast is good, although this part is little bit blurry, but I can still see it clearly. The line also has that oval impression, starting with small dots, then getting bigger and back to small. I was thinking if I put it in my back, it will look very good. Number 44 is almost the same with number 46, but I like 46 better (than 44) because it has more regular shape and distance. Some parts in number 44 have a narrow distance and some parts have a loose one. About number 48, the pattern colour is fading away and also it looks a bit pale compare to their background colour.

I was a bit confused to decide between 40 and 42. Both of them look irregular in terms of the shape of the dots. For example, I see most of the dots in number 46 are circles, where 40, some of the dots look more like triangle or ellipse. I agree with your explanation in the beginning, these could be rejected because it has inconsistency pattern. I prefer a regular pattern. Number 42, there are some areas that have different shape. I didn't see it as a pattern because the position of the irregularity is not in the middle. So, I was thinking maybe it happens because the stitching was misplaced. Number 50 is just too dim. The background colour and pattern almost have the same colour.

A: I realise that in this group, you are more concerned with consistency in distance and shape. Is it true?

B: Yes. For example, in number 40, in one line, they have different shape and contrast. I prefer to have all in one uniformity. Either all circles, all ellipses, all bright, or all dim.

A: Ok, thank you. Let's move to group 4.

Group 4 (42-6-22-40-24-4)

A: Ok, can you explain about this group?

B: Can I explain it randomly?

A: Yeah sure.

B: Ok, pattern in number 4 is very clear. You can see each shape is very clear, all of them in the same ellipse shape. It also has a good contrast between background colour and pattern colour. I can see in the middle is slightly bigger, but it seems like it has a good proportion. Number 24 is very consistent, it starts with small circles and then slightly bigger circles, and then small circles again. The colour intensity is also nice, it starts quite fade and then bright and then it's faded out. I don't really like number 40 because it's not very consistent. Number 22 is not very consistent because the start is very bright and then it faded away. The shape also not consistent in a way that some of them are big and some of them are small. Number 6, background colour and the pattern are not very clear, the pattern disappears.

Background colour in number 4 and 6 looks similar, but pattern in number 4 is clearer. Number 42 is almost contrast, but the pattern is not uniform. There is some anomaly pattern here.

A: Ok, thank you. Let's move to group 5.

Group 5 (26-28-46-8-10-44)

B: To be honest, I don't think I have patterns that I like in this group.

A: Yeah, just pick within this group.

B: Ok, this is the final order. None of them is actually my preference, so I just decided based on the contrast and the pattern consistency, in terms of line and shape. Number 26, it's fading out at the end. It's almost similar with number 28, but number 28 has more regular distance between dots. But I like number 46 better because I think the contrast of background and pattern colour in number 28 is very weak. Number 46, the contrast between background colour and pattern colour is slightly better, I can still see the pattern, although the dots are not really consistent in terms of colour and shape. I put number 8 in the third position because of the consistency in distance between each dot. Although, it slightly faded away at the end. In comparison with number 10 that has a good consistency in terms of space and also clarity. For number 44, I like it because of the background colour. I was confused between 10 and 44, but I choose number 44 because of the background colour that makes the pattern more pop out.

A: Ok, thank you. Let's move to group 6.

Group 6 (50-30-12-14-32-48)

B: My preference actually, the pattern needs to be bold and striking.

A: Ah ok.

B: In this last group, I cannot see any contrast in number 50, but I can see it is actually a good pattern, but I am not sure if it's a pattern or not because of the contrast. Number 30 is not consistent in terms of clarity, some of them are bright and some are dim. I like number 12 better than number 30, although it has a fade part in the middle, but I can see the clear part in both ends. For number 14 and 32 have a similar consistency, but I like number 32 better because it has more contrast, so it's clearer. Background colour and pattern colour are almost the same in number 14. I think it is because number 32 has a darker background colour. I like number 48 the most because the background colour is darker compare to other samples, and the pattern is somewhat consistent. I can still see it from far that it's a straight line. Like number 32, I cannot see the pattern at the end, even worse in number 50. I think the only thing that helps in number 32 is the background colour.

A: Ok, from the whole groups, how do you decide the order?

B: For me, I will see the contrast first, cause then I can see the pattern. For example, black and white, or dark and white is very clear for me. And then I will see the pattern consistency of each dots. I also consider the rhythm from the pattern. For example, if I see some anomaly, but if it's in the middle, I might see it as a good rhythm.

A: Ok, do you want to add anything else?

B: I think that's all.

A: Ok, thank you very much.

Appendix F
Indonesian stitch-resist dyeing: A transformation journey from traditional to contemporary design

This appendix describes an exhibition conducted as part of this study. The exhibition was held in the Foyer Gallery, School of Design, University of Leeds on 29th March – 7th May 2019.

F.1 Introduction

Indonesian stitch-resist dyeing: A transformation journey from traditional to contemporary design. This is an exhibition displaying a journey of learning about the conventional practice of Indonesian stitch-resist dyeing and transforming it into a contemporary context by Bintan Titisari. Stitch-resist dyeing, as a particular form of resist dyeing technique, produces an authentic blurry pattern with multicolours and shade gradation. The definition of stitch-resist dyeing is a resist technique that uses a running stitch to apply a thread into a woven cloth, then the thread is gathered and knotted to protect the area from the dyestuff, and the stitches are cut away after dyeing to reveal the pattern.[1]

Bintan Titisari is a textile craft researcher, designer, and maker who has been focusing her expertise in the stitch-resist dyeing area since 2007. She started her journey by learning the basic technique and design, then evolving her skill at Masters level and by working with the Indonesian craft makers as a designer and maker. Now, she is expanding her knowledge to doctoral degree level at the School of Design, University of Leeds. Her current research explores the possibility for design and technology to contribute in revitalising traditional craft practice by examining the Indonesian stitch-resist dyeing practices as a case study. Indonesian textile craft practices are facing challenges in recent decades in view of a major dynamic shift from material culture into a mass production due to the forces of modernisation and globalisation.

Titisari examines the current traditional practices within Indonesian craft makers in three locations in Indonesia, from the history, social value, pattern design and processing sequence, to the possibility of new design and the use of appropriate technology. The research focuses on investigating a suitable method to develop traditional techniques without losing their cultural perspectives and to sustain the traditions of the community. Her study is

interdisciplinary research, supervised by Dr Muriel Rigout, Prof Tom Cassidy and Dr Alice Dallabona.

The pieces in the exhibition range from the traditional stitch-resist dyed textiles from each location in Indonesia produced by Indonesian craft makers, the working progress from Titisari's PhD research, and the personal exploration works of contemporary designs using a new method of stitch-resist dyeing designed and created by Titisari. Accompanying the exhibition is a slide show which explains the culture and the traditional processes of Indonesian stitch-resist dyeing.

F.2 Documentation of exhibition

Figure F.1 Exhibition display 1

Figure F.2 Exhibition display 2

Figure F.3 Exhibition display 3

Figure F.4 A collection of illuminating *tritik* cloth (Titisari, 2011).

Figure F.5 Contemporary sarong cloth (Titisari, 2019)

Figure F.6 Pink arrow cloth (Titisari, 2019)

Figure F.7 Illuminating *tritik* design in wall hanging and dress (Titisari, 2011).

F.3 Poster of exhibition

Figure F.8 The poster of Indonesian stitch-resist dyeing exhibition