Gold Scrap Collecting Procedures in Jewellery Fabrication Process: An Explanatory Case study

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Abstract

This paper employed the application of explanatory case study methodology to have a deeper understanding and expand the data related to the gold scrap collecting process managed by the SMEs jewellery industries. Eventually, the jewellery making industries will be benefited from the recommendations on how to address the potential loss of gold waste during their day-to-day fabrication and workbench process. To facilitate the research deliverables effectively, an in-depth study on the recommended standards operating procedures (SOPs) practices for SMEs through observation and deep dive understanding on the issues based on research goals and questions have been conducted accordingly. Hence, the case study will be

able to profile and pinpoint key issues and provide recommendations for the future sustainability of the business for SME players.

Keywords: Scrap collecting procedures, Jewellery Fabrication, Explanatory Case study.

Introduction

Gold is known as a valuable and precious material. Gold's prime characteristics of being corrosion-resistant and easy-to-work on makes it highly desirable for various purposes, such as decoration and other industrial purposes. The jewellery fabrication process involves many techniques and tools. This activity leads to gold losses as the physical form of gold will turn into dust and small particles. Therefore, the gold scrap collecting process in every stage of the jewellery fabrication process is a crucial part of the physical form of the material itself. The lack of attention to the process that results in gold losses will affect the long-term business yield and lower the profit margin of the producers. During the fabrication process, the scrap waste will mix with other materials both on and adjacent to the workbench area such as floor and work compound. Usually, right after the process is completed, the quantity and the weight of the raw materials (gold) will be reduced slightly as compared to the original weight measurement due to tech-work processes (Kaspin, S. (2013), O'Connor, et al. (2015). Somehow, the gold waste may now be lost permanently, as the number of losses seems perceived as insignificant and present in a very small quantity.

Gold scrap generated through the jewellery fabrication process can be cleaned and recycled, however, the contaminated mix-scrap and other metal wastes need to be re-collected and be refilled to extract its pure gold element (R. Loewen, (1980), C.W. Corti, 2002) and Kaspin, S. (2008). Consequently, the lack of treatment and care to avoid even the small percentage of gold losses in the jewellery production process may result in a higher amount of loss to the manufacturers, both direct and indirectly. Hence, the proper action must be taken to contain the issues. This kind of norm and usual lack of care treatment to gold waste if not solved may contribute up to 10% of gold losses in one single process (Ibid.) Generally, gold waste or scrap is being produced from many industrial applications such as electronic industry, biomedical, jewellery fabrication and many others. It is important to reaffirm the fact that by nature, the gold metal components are indestructible due to their unique physical and chemical structure. By common practice, such waste can be recycled effectively through the various technique of gold recovery process and reproduced for other applications in industries as reported by KPMG (2006), quoted that in the last five years' gold scrap has contributed about 21 percent of the overall gold supply to the world.

Therefore, this study is crucial to understand how the current practice of the gold scrap and waste collection process is being executed at respective in-house jewellers and fabricators. Usually, based on market practice in SMEs, the Jewellers House would allocate a sufficient ratio from 1 to 3 goldsmiths to fulfil the needs of customer's demand; that includes the jewellery ordering process, cleaning, and alternation process. In general, the gold scrap that's being produced as waste during the jewellery making process, alteration and cleaning process will be collected and sent back to the refiners for the recovery process. The refining or recovery process is a method deployed by refiners as a procedure to extract pure gold (99.9%

purity) by removing all the impurities throughout the process. The refined pure gold can be re-used to produce another form of jewellery and other industry application (Kaspin, S. (2013).

Briefly, the SMEs type jewellery fabrication in Kelantan state uses a mixture of modern and conventional methods in their fabrication making process. Based the survey carried out to identify jewellery houses, indicated that most fabricators use the conventional methods; with 63 cases compared as compared to modern methods with 48 cases. On average, the survey indicated that on average 1 to 1.5 grams of gold will be missing throughout the process (Kaspin, S. et al; 2021). The survey has also found that the production scales by the goldsmith are on average from 1 to 5 items in a week depending on the sizes and types of products requested by the clients.

Hence, the question is whether there is a direct correlation between the number of products produced and the types of methods applied by the goldsmith in determining the percentage of gold losses? Thus, this case study is conducted to have a clear explanation and provide clarity on the big picture on the problem statement on issues relating to gold losses in terms of design selection, process, tools, technique, and equipment used, as well as to link it with current gold scrap collecting procedures implemented by each of SME's Jewellers House especially in Kelantan State.

Jewellery fabrication process

The jewellery manufacturing process is well defined as a first-time transition point of gold bullion into semi-finished or finished jewellery (World Gold Council, 2019). Finished jewellery is defined as complete and ready-to-wear jewellery that is polished and set with all stones (Stuller, 2012). Jewellery is fabricated by joining precious metal segments or parts by soldering or welding them into position. Components used in jewellery fabrication range from heads, cages, or prongs needed for setting gemstones, to clasps, clutches, and earring posts that provide functionality (Robert Underhill, 2022). The tools used by local goldsmiths are usually very crude homemade implements. Most local goldsmith prefers to use pure gold to fashion their jewellery and ornaments because it is soft and malleable. Most pieces of jewellery items are made from gold which has been mixed with an alloy to add strength and reduce the cost. Pure gold is graded as 24 carats and the lowest gold content is 10 carats.

Some gold jewellery techniques require a special tool that can be made from any metal implemented or modified from another tool. Other important tools are the various sizes of homemade chisels, tweezers, pliers, and needle-sharp engraving tools with mushroom-shaped handles known as scribers. In addition to these tools, the goldsmith needs a strong workbench, a small anvil and a lamp or blow torch to fashion his artistic creation. Exclusive jewellery normally fabricated by a skilful and professional craftsman who responsible to identify suitable techniques, tools, and equipment are in making processes. Chris Baber et: al, (2019), believed jewellery making is an area of human activity in which cognition, creativity, and physical performance meet and it is necessary to combine knowledge of metallurgy and gemstones, with craft skills and an ability to create aesthetic designs. The gold-making process involves mastering physical skills than research and it is very much about

craftsmanship, skilfully manipulating tools and materials combining new materials in designs, re-use old techniques and materials in a new way (Jettie Hoonhout, 2011).

Jewellery fabrication (Robert Underhill, 2022)

Jewellery Scrap

The jewellery manufacturing process involves precision designs, setting the metal as well as the stones, polishing, filing, grinding and others that will be changed to the physical existence of gold to waste or scrap (Saadiah Kaspin, 2013). Chris Baber et. al; (2017), in jewellery production mistakes can happen some work can be corrected, and some might be categorized as scrap. This scrap will mix with other materials from the workbench and floor. Jewellery workshops generate three different kinds of waste: handwashing waste, jewellery polishing waste and floor sweepings waste Hand washing waste is generated by the rubbish coming from the hand washing of operators and clothes for laboratory cleaning; it is characterized by an organic matrix in which gold particles are segregated. Accounting for 40.7 % of the total waste from craft workshops, an average gold grade of 2.89 % has been found (Ibid.). Jewellery polishing waste is generated when the artifacts are cleaned and polished using bristles of different hardness running over their surfaces; it is characterized by a mixture of plastic and metal bristles, abrasive paste, and metal dust, mainly composed of gold alloys.

The sources of the gold scrap and waste can be found from all stages in the jewellery fabrication process whether by machine or handmade such as cutting, grinding, filing and manual polishing on buffing wheels, sawing and others which are dropped on the workbench and the floor, and airborne particles that settle as dust a work-surfaces, pipes and operatives clothing or may even be vented to the outside and lost. Any cleaning and machine finishing operations can occur the gold-bearing material being washed down when draining process and this includes all gold-containing solutions from electroplating, acid stripping and others. Scrap can be referred to as recycled, used, or laundered gold. In Malaysia, about 41% of the gold supply in Penang is collected from scrap through the refining process (Anna Ong, 2012).

C.W. Corti, 2002), referred to an example of gold scrap that occurred from both traditional workshop and factory situations. Efficient recovery of scraps and wastes does

depend on knowing how much precious metal enters the factory or workshop and how much leaves it in the form of finished jewellery. This is coupled with how much scrap and gold-containing wastes are knowingly recovered and either recycled or sent for refining which enables the jeweller to know how much is being lost in the system and appropriate action can be taken to recover it. On the other side, the jewellery making process will always generate various forms of metallic such as cadmium and non-metallic exposures produced from the buffing and polishing stages that caused the potential of health concern. This could be related to the unsystematic procedures applied by the fabricators or manufacturers that potentially can create a long-term health problem in the long run (Moitra S. et al; 2013). This material can be refined directly by simple melting with a flux.

Whereas the low-grade scrap contains about 0.1% to 8 – 9 % of gold contain including floor sweeping, polishing dust, spent plating solution, rags and tissues plated base metals. The low scrap also may contain additional wet sink trapped sludge, sludge from jewellery tumblers, carpets, wood flooring, watch band and spectacle frames and others. The amount of scrap generated can be controlled through careful process design, material utilization and implementation of best practices on the shop floor, but it cannot be eliminated. Gold waste can arise at the following stages (K. Chandrasekaran, 2011) in (Table 1.0).

Table 1.0: Stage in jewellery production creates waste

STAGE	**REMARKS**
During design stage	Work that can be proactively avoided can be decided at this stage so that practices
During planning stage	Planning and scheduling can be done in a manner that prevents loss of time, fewer inventories and so on.
During operations stage	This is reactive as compared to the earlier actions and is to be addressed after the process is in place

Sources: K. Chandrasekaran, (2011).

K. Chandrasekaran, (2011), studied the stage in the jewellery fabrication process that led to the waste can be divided into 3 stages which are during the design stage, during the planning stage and the operation stage. The study analyzed that the procedure must be planned accordingly before starting all the processes in jewellery fabrication started. The decision-making in the designing stage will help the goldsmith and craftsmen to decide the right action to avoid such significant gold losses through gold waste. Peter Raw (2000) stated that types of design are one of the factors in gold losses as the selection of tools and equipment used depends on the types of design which is more to the contemporary or traditional approach. Therefore, as early as the designing stage, the analysis of the types of jewellery design is crucial. During the planning stage, the prevention of loss of time can be analyzed by referring

to the current value stream mapping (VSM) implemented in the jewellery fabrication process (Saadiah et al; 2021). This process will help to identify and isolate the types of scrap, validate their sources for both allocations and trace for inventory purposes. In the operation stages, the comparison needs to be made in both situations; that is during the earlier stage of the fabrication and after the process.

The waste particles produced during this kind of fabrication process are normally light and settle like dust on the work surfaces, pipes and operating clothes and are hard to retrieve. Hence, it has a direct effect on the hazard conditions of the craftsmen's table/ workshop with concern on the air circulation. (Raw Peter, 2000), (S. Kaspin, 2013), (K Saadiah and N Mohamad ,2015) and (S Kaspin et al; 2021) have analysed factors that can lead to gold losses in a small or large amount especially in small scale and enterprise jewellery industry in (Table 2.0).

Table 2.0: Factors of the Gold Losses

(Raw Peter, 2000)

Factors	Reason
Poor Condition and Design of the Premises	To collect waste from the jewellery fabrication process such as dust, filing, small particles the premises are required to have a routine schedule and proper facilities.
The type of manufacture	The number of gold losses is higher if the manufacturers produced products manually as compared to the mass production scale produced by machines.
Type of Jewellery Design	The traditional design is very complicated to fabricate and contributes a higher amount of gold losses compared to contemporary and modern design which is simpler and plainer.
The condition of Machinery or equipment	The poor maintenance and aging machines will contribute more unexpected losses to the manufacturers.
The management attitude	The manufacturers must be responsible for the higher standard operating process of housekeeping practices systematically managed to avoid unnoticed gold losses during the fabrication process.

(S Kaspin, 2013), (K Saadiah and N Mohamad, 2015)

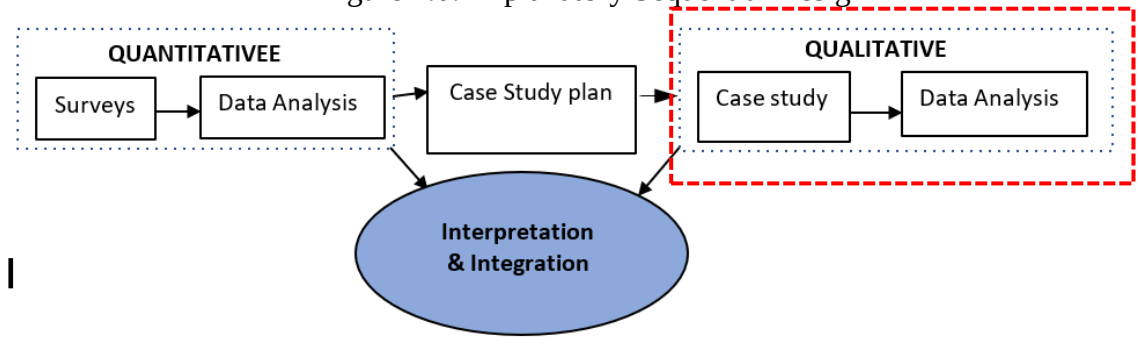
Factors	Reason
Unsystematic and unsafe procedures in handling waste.	The process has caused environmental pollution due to improper handling of the chemical and the purity of gold recovered doesn't meet the standard.

Methods

The Explanatory Design can be categorized into two variants, which are the follow-up explanation model and participant selection model (Creswell, 2003). The difference between two variants in Explanatory Design which is the follow-up explanation model and selection of participants will be referring more to the main purposes of the research study to be conducted. This research study utilizes Explanatory Design: Follow-up Explanation model as the purpose of the study to identify the root cause of the gold losses in jewellery making process was examined through observation process. The research approach is an explanatory case study that was conducted in a selected Jewellers House. This study's goals are to identify and record the current practice implemented by the manufacturers in handling the waste from the fabrication process. Secondly, is to review the current standard of procedures (SOPs) and how they control and processes of handling the gold waste during and after the fabrication process. To ensure the result and analysis on the gold waste-collecting procedure being implemented in the small-scale industry, mixed-method sequential design has been used to get more elaboration and expand to support the results of the findings of one method to another method.

In this research, the explanatory case studies involve detailed exploration with a few cases or individuals to provide a clear explanation about the root cause and defining problem in the research study. The first challenge in Explanatory Design: follow up explanation model is when the result of the quantitative phase must be analysed and obtained to determine which quantitative results need further explanation in the qualitative phase. However, the other options can be used by selecting the significant results and strong predictors can be discussed and weighed as the study is being planned (Creswell,2003). Secondly, this design requires a lengthy amount of time for implementing the two phases due to the first challenge, however, the participant involved in the qualitative phase can be limited to a few participants. This study is following the Mixed Method Explanatory Design: follow up explanation model as explained in (Figure 1.0) below. Therefore, the objectives of this study were developed based on the analysis from the survey.

Figure 1.0: Explanatory Sequential Design



Designing A Case Study

As discussed earlier, this case study is conducted to get more information and data by using "How" and "Why" as directions and guidelines. The case study is designed based on the theoretical framework gathered from the literature review and survey analysis on the losses of

gold during the fabrication process. As regards, the above-mentioned issues, this case study implements the instrumental method via an on-site observation approach. The study will identify whether the current practice of the jewellery waste management process can minimize the gold losses and reduce the waste sources. The objectives of the case study are as follows:

i. To identify the current practice implemented by the manufacturers in handling the waste from the fabrication process.

ii. To analyse the root cause of gold losses during fabrication stages for further improvement.

Whereas the objectives of this case study are referring to the research questions is tabulated in Table 3.0.

Table 3.0: The RO and RQ of the case study

Research Objectives	**Research Questions**
RO1: To identify the current practice implemented by the manufacturers in handling the waste from the fabrication process.	**RQ1**: How do you know the gold is lost? **RQ3**: Why gold is lost? **RQ2**: How does the gold collecting process has been carried out?
RO2: To analyse the root cause of gold losses during fabrication stages for further improvement.	**RQ1:** How does the goldsmith control the gold scrap losses from the early stage of the process? **RQ2:** Why the issue occurs during the process?

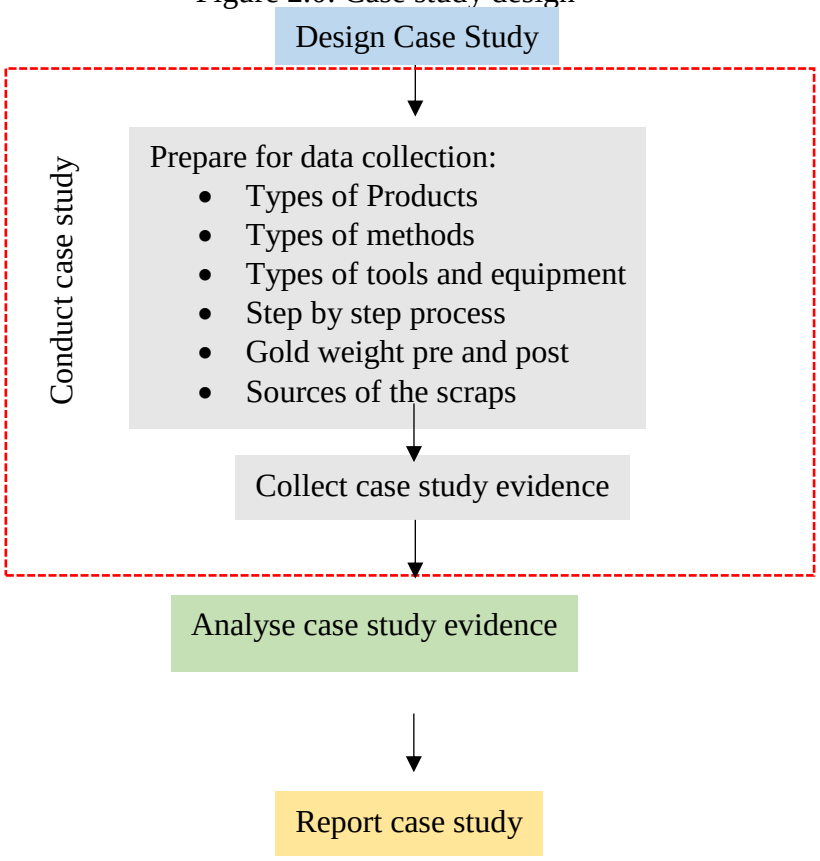
Selection of Participant-The Rationale

The rationale to select the right participant was indeed made based on the study scope, research objectives and research questions. The target audiences are defined Jewellers House Company which provides an in-house goldsmith to fabricate and produce jewellery for customers or shop collection is chosen to be as the participant. The study was conducted in Kota Bharu Kelantan, considering the state's popularity in the jewellery and gold-making industries. Based on public records, Kelantan state is positioned as the second larger gold producer with 1,006.661 grams of gold with 5 gold mines. Therefore, the performance of SMEs jewellery industries in Kelantan should be synchronized with the fact of the number of golds produced by the state and the higher number of Gross Domestic Product (GDP) in the manufacturing sector in Malaysia (Press Release, Department of Statistics (DOSM), (2018).

Hence, the priority should be initiated to improve and enhance the performance of the SMEs jewellery industry in Kelantan.

Mostly Jewellers' houses in Kelantan do involve in many relevant activities; as it is entirely on selling and fabricating the product, but they also offer other relevant services such as trade in gold, product repair, product designing, gold specifications identification, refining gold and others. An in-depth observation on the gold scraps collecting process that is applied by the Jewellers House. Indeed, it will enhance and increase the data explanation on how and why the gold losses happened during the jewellery making process. The design of this case study (Figure: 2.0) was built to have more explanation and align it to the objectives validated by an in-depth. The decision to apply multiple cases in a single case is to find the similarities across cases (Roberta Heale, Alison Twycross, 2017).

Figure 2.0: Case study design



Adopted from (YIN R.K, 2003)

Findings

The jewellery fabrication process involves many stages depending on the type of design. In jewellery fabrication processes such as selection of tools, equipment and techniques used is important to accomplish the desired product. The jewellery making process not only resembles the skills of the goldsmiths but also the creativity, finest and niche of each product. An in-depth observation has been carried out based on 4 types of cases study on the gold

jewellery fabrication process. The details on the types of products, types of tools and equipment, gold weight, scrap weight and sources are tabulated in Table 4.0.

Table 4.0 Summarise of gold jewellery fabrication process – an in-depth finding analysis

Case study	Types of Products	Methods	Gold Weight (gm)		Weight Scrap Gold (g)	Scrap Sources
			Pre	Post		
Case 1	Pendant	Modern and Traditional	10	7.3	Nil	1. Piercing technique 2. Finishing process 3. Filing process 4. Repousse and chasing technique
Case 2	Love Ring	Modern and Traditional	2	1.3	Nil	1. Cutting process. 2. Finishing process 3. Filing process
Case 3	Pendant	Modern and Traditional	2.3	1.5	Nil	1. Piercing technique 2. Finishing process 3. Filing process
Case 4	Pendant	Modern and Traditional	2	0.9	Nil	1. Finishing 2. Filing process 3. Cutting 4. Piercing

**Nil=not in list*

As stated earlier, the gold properties which are soft and malleable will contribute to the scrap form. The techniques, tools and methods in the jewellery making process will lead to the cause in changing the physical form of gold generally. The process starts with the preparation of gold scrap. The source of gold scrap is collected from the previous jewellery making process. To change the physical of gold scrap into gold bullion form to allow it can be re-used, the gold scrap needs to go through the melting process. This process will remove all the impurities blended in the gold dust by using the 'flux' as a removing agent. Through the observation, the weighing process is only documented and implemented after the gold bullion process and during the completion of the product.

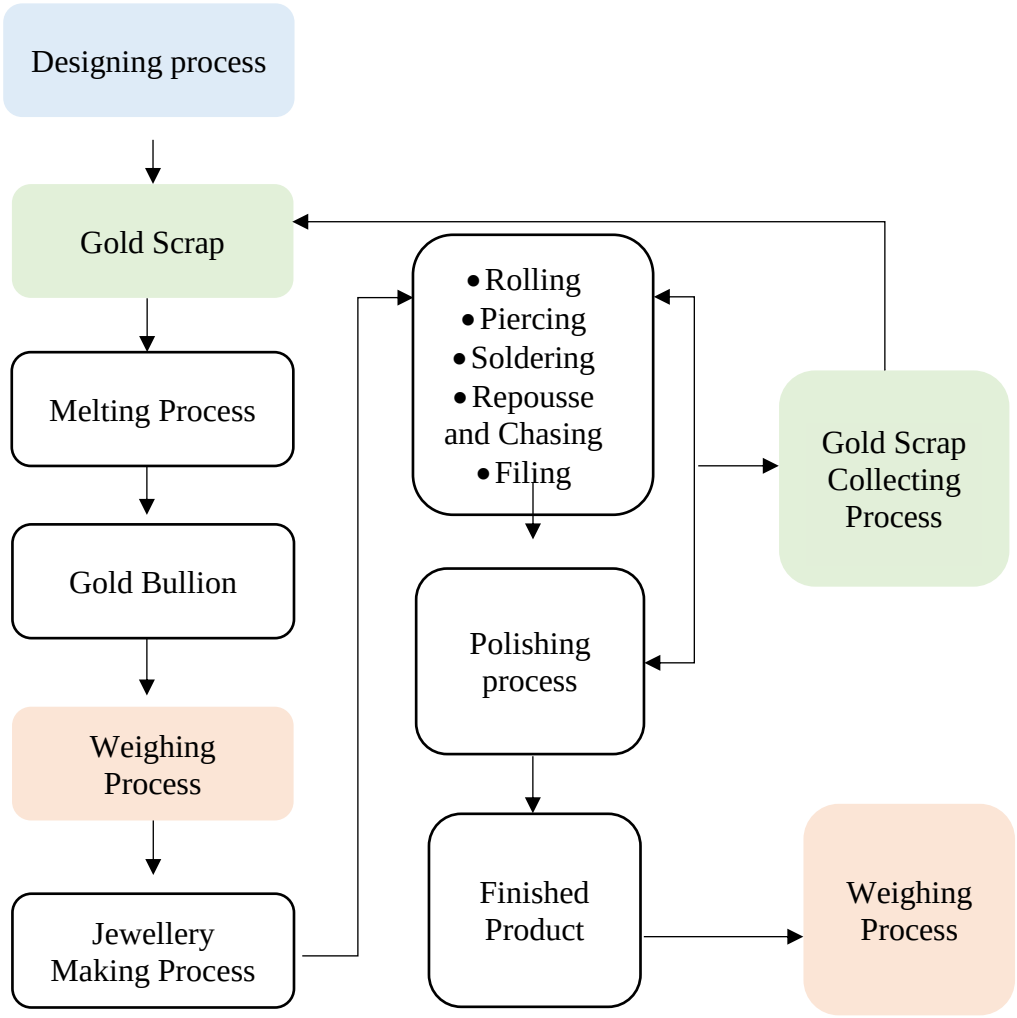


Figure 4.0 Current practice of gold jewellery fabrication process

Results

The results from the case study indicated that a high percentage of gold losses are not documented properly as the weighing process only happens in the early and final stages of fabrication. Based on the calculation, the different weights of gold can be analysed through the quantity of the different weights of gold bullion and finished product as in (Table 5.0). The different types of gold weight for the pre-and post-process were influenced by the quantity of gold used in each making process. In Case 1, the difference of weight between gold used and the finished product is 2.7grams. On the other hand, in Case 2, 3 and 4 the difference of weight between gold used and the finished product is between 0.7 to 1.1 grams only.

Table 5.0 Quantity difference of gold weight in pre and post jewellery fabrication process.

Case study	Methods	Types of Products	Gold Weight (gm)		Weight Different (gm)
			Pre	Post	
Case 1	Modern and Traditional	Alphabet Pendant	10	7.3	**2.7**
Case 2	Modern and Traditional	Love Ring	2	1.3	**0.7**
Case 3	Modern and Traditional	Pendant	2.3	1.5	**0.8**
Case 4	Modern and Traditional	Pendant	2	0.9	**1.1**

Discussion and Recommendation

The current practices of gold scrap collecting procedures seem was not the main concern to the Jewellers House. Based on the researcher's observation, the gold scrap did not well track, inventoried, organized, and documented. The gold is only being measured after the bullion-making process and when the product is completed. Throughout the process, no documentation on the quantity of gold is recorded which creates the problem of how to evaluate the exact amount of the gold losses. The scrap yields throughout the process are not weighed and documented at the end of the process. The untreated gold scrap will cause the loss to the manufacturers in the long run as the gold is a valuable material even if it was combined and mixed with other materials. As the current practice, the gold scrap will be collected in every stage of the process and re-use again for another making process without realizing the actual number of golds has been a loss in every production process. The gold bullion produced from the melting process of re-use gold scrap is also not being tested to identify the gold purity percentage. Despite the melting process using 'flux' to remove the impurities, the purity of gold is difficult to measure. As discussed earlier, the gold scrap yields during the process will eventually mix- up with other material as its physical existence in dust and small particles (Saadiahk et al; (2019), Kaspin, S et al; (2015), Kaspin, S. et al; (2009). Therefore, purity testing should be run to ensure the quality of gold is meet the standard of gold purities in the market (Kaspin, S., & Mohamad, N. (2015).

The selection of the method used in making process also contributes to the number of gold scraps. Through the observation, the methods used are a combination of modern and conventional methods. However, the modern method is only referred to the application of

desktop during the designing process and rolling mill to layer the gold into sheet form in the early stages. The rest of the process is using conventional methods in terms of types of tools, techniques and equipment used. The sources of gold scrap can be seen through the filing, piercing, repousse and chasing, cutting, and polishing process. The goldsmith's behaviour is also contributing to the gold losses as the neglect in treating the scrap. This is where the manufacturers or owners of the Jewellers House should take an action to provide their workers with knowledge and skill in documenting and organizing the materials. Types of selection design is another reason for the gold losses as case 2, case 3, and case 4 produced Alphabet Names which the process and techniques will be using more piercing and filing techniques. Piercing and filing techniques are known as key processes that contribute to the highest quantity of gold scrap (Saadiahk et al; 202).

As discussed earlier, the producers and manufacturers or the owner of the Jewellers House were unable to do a thorough analysis on the number of gold losses throughout the process. They even do not realize if the gold is missing or not during the entire process. The lack of care and attention on the gold scrap management procedures did not only create problems on the actual quantities of gold missing but, to the extent of the quality issue of the product. This case study has been developed to explain the research objectives and research questions on the gold scrap collecting procedures. Hence, further improvement on the key processes needs to be developed to help and assist the Jewellers House to be able to record and enhance the awareness on the importance of organizing and documenting the gold scrap as a valuable material. These unintended actions of lack of care and mistreatment by the jewellers have led to a lack of inefficiency in tracking and managing the waste or scrap during the fabrication process such as proper inventory system, quality testing, documentation, and checkpoint. This stage is linked and connected to assure the gold scrap is successfully managed and purity of gold can be assured.

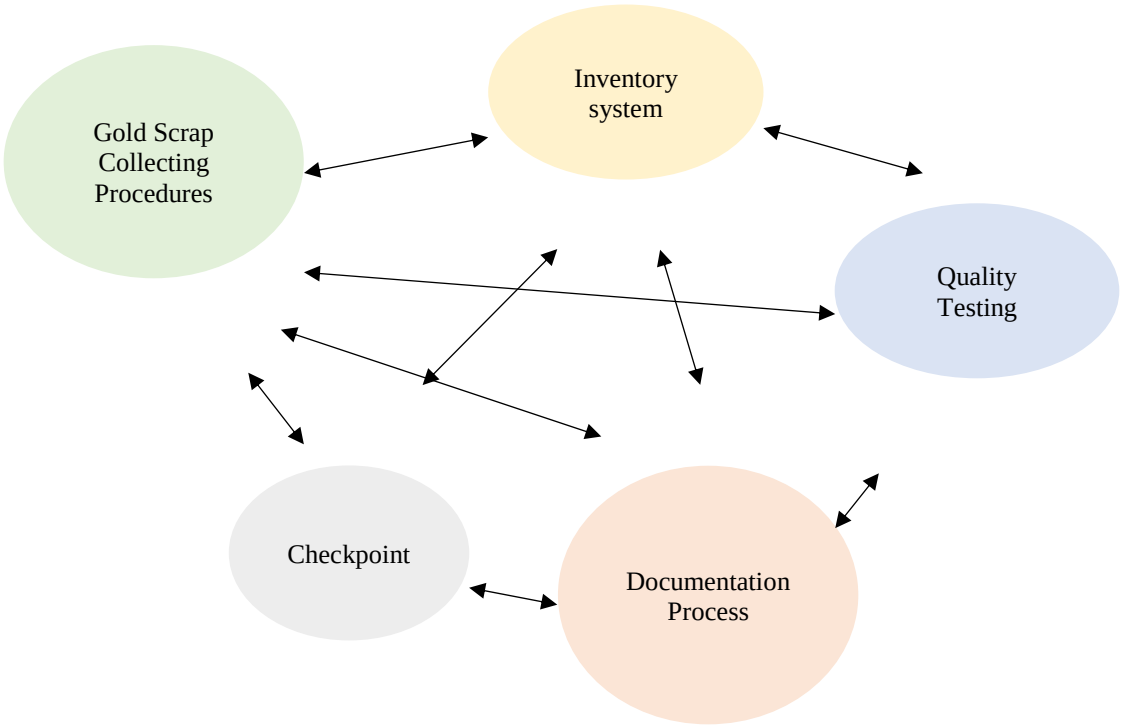


Figure 5.0 Areas of improvement in the gold scrap collecting process

Figure 5.0 shows the correlation of inventory system, quality testing, documentation and checkpoint in gold scrap collecting procedures. The inventory system is supposedly involving documentation, quality testing and checkpoint. The goal of the inventory system in the jewellery fabrication process will help the jewellers or goldsmiths in tracking the quantity of gold used throughout the process and recognize the location of the products, materials and in workshop or workbench. This process will determine the stock level of the gold and regular (monthly, yearly) stock take is conducted to monitor the usage of the gold. Each component of the equipment and the fabrication area such as the exhaust system, drain, walls, roofs, floors and working clothes will be cleaned to ensure each of the gold waste could be recovered. In comparison, quality management is a crucial part in determine the quality of a product following the standard of gold purity. The quality of the product will be justified by the testing process which needs to be documented and justified in an inventory system. The checkpoint will benefit in identifying the important risks and issues during the process. Meanwhile, the documentation purposes to keep track of a process during the fabrication of a product. The goal is to learn from the implementation so you can adjust the strategy and improve the procedure.

Conclusion

The procedures implemented by the jewellers are determined by the type of manufacturing (Peter Raw, 2000) requirement. The percentage of gold losses is higher should the manufacturers produce products manually as compared to the mass production scale produced by machines. As discussed earlier, through the survey, most of the jewellers still use the traditional method in their process. The decision on applying the traditional or modern technique would refer to the affordability of manufacturers to provide the new technology in producing a product. The rationale of using the traditional methods is also to fulfil the requirements of the customers.

Although traditional design concept may affect the current jewellery industry players in sustaining the business, it will not give much impact on the jewellery industry in Kelantan as the uniqueness of the traditional design concept and craftsmanship becomes its unique selling proposition as the main attraction of tourists and loyal buyers (Parul Agarwal, 2017). Therefore, the lack of care and inefficient processes to avoid the gold losses must be addressed seriously despite a continuous demand for a traditional design; to ensure future sustainability (Kaspin, S. et al; 2021), (Mohamad, N., et al; 2017). The improvement needs to be a focus on the procedures during the jewellery fabrication process which is focused on the types and sources of scrap that resulted from the process. Kittichok Nithisathian et; al (2012), for instance, has claimed that the Thai fine gold jewellery industry is lacking attention on research and development and in terms of production, as they still rely on traditional jewellery crafting technique that produces a higher population of gold scrap and waste; makes this kind of mystify way of management make it difficult to develop and manage. Therefore, in comparison, the Thai fine gold jewellery needs to improve its IT systems,

processes, advanced its management methods, and fresh ideas should be added into these companies to follow the economic development such as customer orientation, information management system, flexible operational process, and others to sustain (Ibid.). Chris Corti (2014) expected old technologies to rise again with new developments in 2024. The motivation to improve operational efficiency in both use of materials and yields is clear to ensure long terms business sustainability and with the right attitude, approach and systematic procedures may help the SME gold producers and fabricators leading to a reduction in costs, widening of design opportunities and the customizing of design, in line with the perspectives and views by Chris Corti (2014) and (Kittichok Nithisathian et; al, 2012), should be considered and adopted by the jeweller players in Malaysia.

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