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Development of a New Loom: Challenges and Prospects

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ABSTRACT

Traditional Kente weavers over the years depended largely on technology in designing and producing their woven products. The gradual transfer of technology from indigenous to contemporary ones, can be seen in the nature of design weaves as well as the looms used to produce these woven products. Efficiency of traditional weaving looms is vital as it increases the rate of production and application of available resources though weaver's dexterity as these factors contribute to loom efficiency. The study sought to minimize the intrinsic loss of time and energy of the weaver by introducing the letting-off of the warp and taking-up of a cloth mechanism to effect loom operational efficiency while the weaver sits in the weaving position. A descriptive methodology was adapted to record, interpret, identify and describe the various faults at the loom operation and weaving performance to ensure aptness of loom design, its production and the functional efficacy of the improved traditional loom. The impact of loom productivity by knowledgeable users (50 weaving operators) attested to the efficiency of the loom. Further revision is bound to occur in the future as technology advances.

Keywords: Traditional loom, Kente weaving, loom technology, efficiency, Ghana

INTRODUCTION

The changing pace of technology in loom design and production cannot be overemphasized since the inception of Kente weaving in the kingdom of Asante, Ghana. Outstanding fabric quality and maximum productivity are the two major requirements in today's competitive fabric-making method (Hari & Behera, 1994). The development of traditional loom and woven fabrics has undergone a number of changes. Basically, the improvement of traditional weaving is designed to achieve four primary objectives: to increase productivity, to improve fabric quality, to reduce the number of manual operations, to use appropriate technology for better weaving operations and hence to reduce the cost of production. To increase loom performance in terms of productivity has been the main goal of any loom producer. According to Hari and Behera (1994), the loom producers now demand for more automation, more versatile and better quality products in line with the fast changing trend in fashion design.

The Asante traditional Kente loom is a device used to weave Kente cloth. Its basic purpose like any other loom is to hold the warp threads under tension to facilitate the interweaving of the weft threads. Though the type of loom and its mechanics may vary, the basic function is always the same (Goli & Deshmukh, 2014). The Kente weaving is a traditional business of the Asantes. Over 10,000 active weavers can be found in Ashanti alone, still engaged in the sector using the traditional loom referred to as '*Kofi Nsanua*' despite its slow and low performance, and competition from the automated factories. Currently, these weaving looms are being used in some art related institutions and homes in the regions of Ghana. The art of weaving is an integral part of the culture and life of the Asante's transferred from one generation to the next and passed on through oodles of modifications over the years. This tradition contributes significantly to enrich the social, economic and cultural life of the Asantes (Bernheimer & Keogh, 1995). The traditional loom structure has progressed from a humble design to what is known today, though economically dependable (Asmah, 2004; Asmah et al., 2015), this handloom, at every stage of its development have created enormous designs, colour effects, texture of weaves to the admiration of many, both in Ghana and abroad (Ross & Adu-Agyem, 2008). However, the challenges posed in its use unveil loss of man hours starting from the warping stage to the weaving stage. At the weaving stage, the weaver is forced to get up from the weaving position to release the warp roller and the cloth roller respectively every time weaving is exhausted (Asmah, 2004; Mohamad, 1987).

After critically studying under a few indigenous weavers in Ghana, the late Lionel Idan (1922-1982), a former lecturer and the founder of the Department of Integrated Rural Art and Industry of the College of Art; Kwame Nkrumah University of Science and Technology, realized the need to modernize the equipment and techniques of the traditional rural cloth weaving in Ghana (Asmah, 2004). After analyzing the operations of the traditional loom, an attempt was made to minimize its shortcomings, such as the time wasted during pre-weaving and weaving operations, to reduce the excessive stretch of warp beam and to eliminate the drag weight so as to save factory space. As a result of the above deficiencies enumerated, the loom redesigned (referred to as the '*Boku* loom') was remarkably improved. The *Boku* loom has been in existence for about 30 years now (Asmah, 2004). It has performed and continues to perform efficiently. Notwithstanding, it has some limitations regarding the let-off and the take-up mechanism in its operations, which this study addressed (Asmah, 2004; Asmah et al., 2015).

In every weaving industry, be it indigenous or modern, the fundamental operational procedures are: (a) shedding (i.e., dividing the longitudinal threads called 'warp' into two sets), (b) picking (i.e., insertion of transverse thread called, 'weft' into the space created by the division of warp sheets) and (c) beating (i.e., pulling the inserted wefts, one after the other to form cloth). However, to maximize time and efforts, the procedures must be followed to speed up production (Barlow, 1878; Mark & Robinson, 1976). In order to keep pace with the fast growing demands of the global world, the need to tackle this setback becomes paramount in order to enhance the effectiveness of these fundamental principles outlined above to facilitate fast weaving. These lingering problems were addressed as some of the loom parts were introduced and some modified to attain a reasonable continuous, efficient and cost effective way of weaving.

Discovered inefficiencies

After careful observation of the traditional *Kofi Nsadua* and the *Boku* loom, the following problems were outlined and addressed. They are the weaving adjustments, i.e., after weaving about 20cm of cloth, the weaver has to get up, move from the cloth-end of the loom to the warp-end of the loom to loosen up the primitive *twesoo* or a locking device at the warp beam, return back to the cloth end, roll about 30cm of the woven cloth on the cloth beam, return to the warp-end to lock up the locking device or secure the *twesoo* again and finally resume his seat to continue weaving. Next, is the narrow size of reed, i.e., the narrow size of reed normally used produces a narrow stole, which makes it difficult to produce a wider piece for a full cloth in the shortest possible time and lastly the warp entanglement: i.e. during weaving, warp yarns usually get entangled frustrating the weaver, resulting in a waste of time. Though downtime and loss of weaving time in weaving are inevitable, prolong occurrences is a major problem that needs to be resolved (Asmah, 2004).

The downtime

This reflects the time it takes the weaver to get up from his weaving position of the warp beam before releasing the lock attached to the warp roller and back to the weaving position to roll of the cloth beam, then back to the warp roller to secure the lock before returning to the seating position to stretch the warp via the cloth roller. The down time also include all the interruptions, loss of time and any events that stop weaving process for a significant length of time. Such events may also include loom operational failures, yarn shortages during weaving and switch over time which delays weaving operations. Though in the context of traditional weaving, it may not be possible to eliminate downtime, however, it can be minimized to enhance actual operation time and not to compound the loss of weaving time (Goli & Deshmukh, 2014).

Loss of weaving time

The loss of weaving time reflects the speed loss that occurs in the course of weaving which retards the operational process to affect the ultimate maximum possible speed or regarded speed during normal weaving. Though this may include the wear-and-tear of the loom structure, poor quality of yarn for weaving, and lack of dexterity of the weaver, the changeover or the switch over that goes on during weaving constitutes a major factor to loss of weaving time (Roy & Basu, 2010). Other factors that are equally important to loom designing are the noise emission and the vibration the loom generates in the course of weaving. The major unavoidable noise sources of the traditional looms are the moving parts of the loom including picking and shuttle mechanisms. Notable success has been realized to minimize the noise emission and the quality of loom structure, by the use of ball bearings.

MATERIALS AND METHODS

The study mainly employed a series of studio experiments of qualitative research, and depended on studio activities which required the use of essential materials such as metal rods, Tape measure, bars and plates, 2″, 2½″nails, 3/4 plywood, pins, glue, nylon cords and redwood, used for the beams and the structural frame of the loom and "*Ofram*" board was used as the cover for the floor of the loom. The qualitative research gave a holistic picture of what goes on in the weaving industry (Frankel & Wallen, 1996). The purposive sampling technique was used in selecting the materials and tools for the study. The tools and equipment employed in the project included, the working bench, sash clamp, try square, a pair of pincers, power drill, chisels, spanner and jigsaws. Bolts and nuts were used to fasten the joints of the project, A bicycle mechanism consisting of bicycle hub and driven sprocket, bicycle cranks and driving, bicycle chain (used to facilitate the rotation of the warp beam after weaving), power grinding machine, welding machine, sanding machines, hinges, ball bearings, bearing cases, hand saws, ripping saw, ratchet wheel, ratchet pawl, smoothing plane, mallet, hammers, camera and computer. Various grades of glass, paper, sanding sealer, acrylic paint and oil paint were used to give the loom a neat finish. All materials, tools and equipment were purchased at the local timber market and Suame magazine in Kumasi (Asmah, 2004).

The methodology adopted helped to study loom construction procedures, the characteristics of loom weaving and its relation to other forms of looms precisely traditional looms. The studio experiment methodology helped to use the analysis established in the methodology to produce the enhanced loom through its design, construction and testing. The design drawings were produced in Photoshop software (Figure 2a & 2b). The activities of the experiments conducted and its results were recorded carefully, and critical observations were made (Asmah et al., 2015). The project was descriptive-analytical and was based primarily on the primary and secondary data, collected through interviews with the major stakeholders. It was also used in the presentation of the various steps and procedures associated with the construction of the loom. The re-design and reconstructed loom measured 72″ x 36″ x 72″ and this was based on the existing traditional loom design (Figure 1). The main objective was to reduce the time spent on the adjustment mechanism during weaving, to provide a 12-inch reed size and produce a warp rack to reduce the incidence of entanglement during weaving.

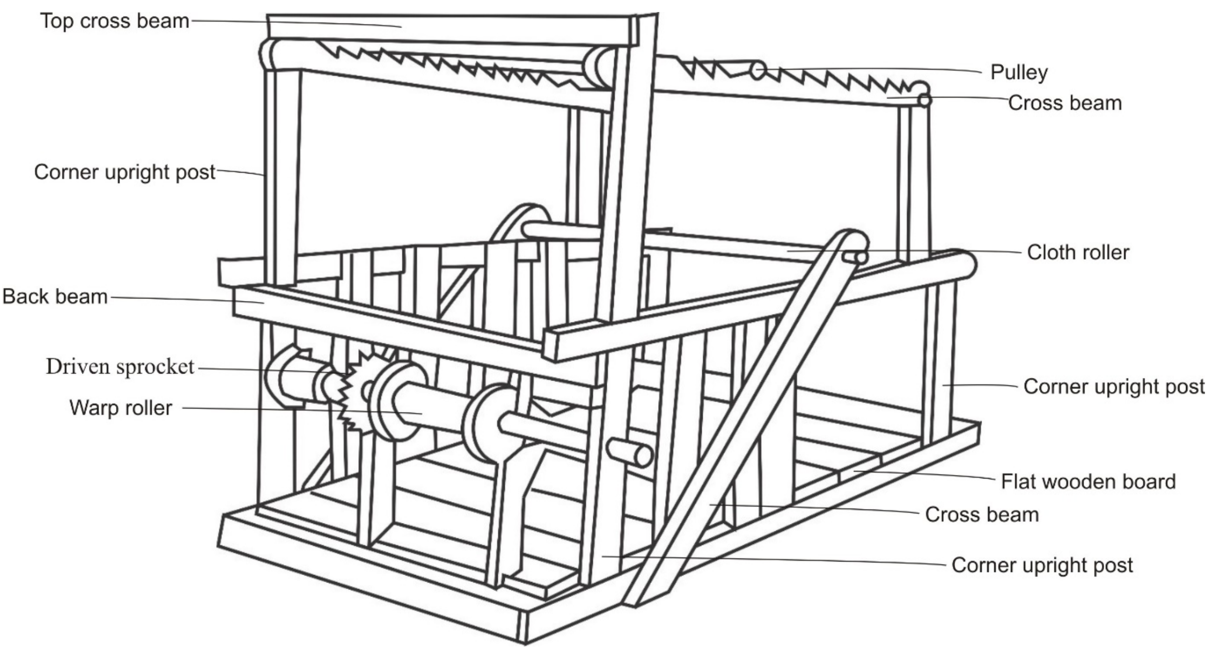

Figure 1: Final design of the improved traditional loom

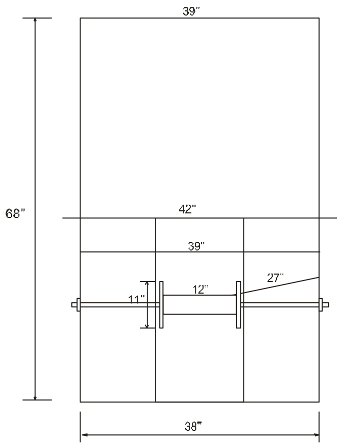

Figure 2a: Front view of the improved traditional loom

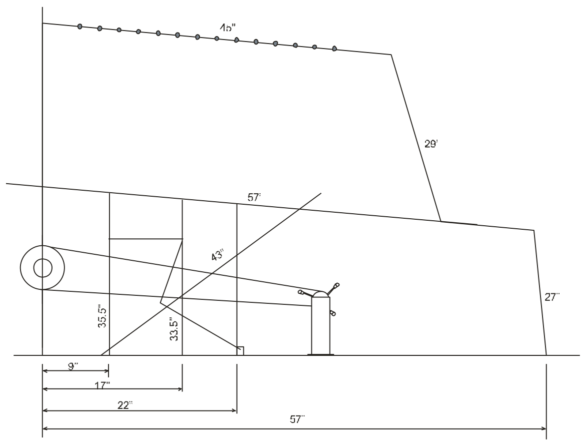

Figure 2b: Structural view of the improved traditional loom

The constructional processes

Following the design on paper, the various members of the loom were cut with the help of a hand saw and a jigsaw. Hand planning was done where necessary to remove rough surfaces of the wood and thus smooth the surface. In order to construct the base frame of the loom, a simple mortise joint was made to facilitate easy assembling and dismantling (Figure 3 & 4). This measures 57 x 38 inches and was assembled temporarily with 2 inches nails. The two upright posts in front of the loom were made based on the mortise joint, but this time vertical to the base frame measuring about 68 inches from the base frame. The other two upright posts for the back were based on the process of the front ones measuring 28 inches at right angles to the base. Linking the two sets of upright posts, four other horizontal bars (cross beams) were joined together on the sides slanting slightly towards the back of the main frame. The topmost ones measure about 45 inches each while the other two measures about 60 inches long.

Figure 3: Drilling holes for bolts and nuts

Figure 4: Fastening with bolts and nuts

The Heald ladders were serrated to regulate the movement of the pulley bars. Another set of upright posts about 30 inches long was incorporated to link the Heald beams and the side braces "*ntoho*". Two bars: the warp carrier "*Ponko Dua*" and upper cross beam, connect the two front corner posts. However, the warp carrier was made by lathing a piece of wood about 40 inches long with a diameter of about 1.2 inches. The main frame was assembled together by means of bolts and nuts, screws and nails as and where necessary, providing a firm structure (Figure 5 & 6).

Figure 5: side view of the assembled loom

Figure 6: front view of the assembled loom

The base of the framework was covered with flat wooden boards (Figure 5 & 6) and the weaver's seat, positioned in such a way to allow the controlled mechanism placed about 18 inches closer to the right side of the weaver's seat on the base board. The four distributors or lams measuring 2 feet (61 cm) long is pivoted to link 17 inches (43 cm) long treadles. The one foot (30 cm) long each of the four heddle frames is referred to as *Asa*. The first two Heddles (*Asatia*) were used for plain weave whilst the other two (*asanan*) were normally reserved for design weave. The four heddle frames and the beater or reed were suspended by means of cords on two pulley bars placed in the notched bars on top of the frame. These bars were lathed pieces each with a diameter of about 4 cm (1.5 inches) and a length of 60 cm (40 inches).

Small wooden frames, fixed with wooden spools to the flanges served as pulley blocks. These were fixed between the pulley bars supported to the four heddles. The heddles were in turn linked to the treadle frames and treadles by means of nylon cords with each treadle taking a heddle. The spool facilitates the free, up-and-down movement of the heddles. The warp beam unlike the normal ones extends between the two front upright posts. This was to provide space for the fixing of a bicycle sprocket; ratchet wheel and ball bearings as the main mechanisms of the loom. The warp beam was a lathed piece of log with a diameter of about 10 cm x 10 cm (4″ x 4″) and a length of about 107 cm (42 inches). Below are the cutting list carefully calculated for the construction of the improved designed loom (Table 1). Two ball bearings were provided at the extreme sides of the front upright posts providing free movement of the warp beam during operation to wind and unleash yarns during weaving.

Table 1: Cutting list

No.	Name of parts (Items)	Quantity	Length	Width	Thickness	Material
1	Corner or upright posts	2 pairs	i. 68″ ii.28″	3″	1.5″	Redwood
2	Cross beams	2 pairs	i. 60″ ii. 30″	3″	1.5″	Redwood
3	Warp carrier/ back beam	1	40″	1.2″	1.2″	Redwood
4	Floor beams/ base frame	2 pairs	i.57″ ii.36″	3″	1.5″	Redwood
5	Warp beam	1	42″	1.5″	1.5″	Redwood
6	Top cross beams	1	39″	3″	1.5″	Redwood
7	Flat wooden boards	5 pieces	36″	12″	1.2″	Redwood
8	Heddle frames	4	12″	-	-	Rattan/nylon
9	Pulley/horses	3	-	-	1.2″	Redwood
10	Pulley bar	2	40″	1.2″	1.2″	Redwood
11	Cloth beam/ roller	1	40″	1.5″	1.5″	Redwood
12	Treadle/foot pedal	4	17″	2.5″	1.5″	Redwood
13	Treadle frames	4	24″	1.2″	1.2″	Redwood

Finishing

As a means of preserving the wood and metal from the excessive effect of weather and the possible attack of insects, a form of finishing was employed. In the case of the wood, an acrylic paint was used to enhance its aesthetics and to prevent insect infestation (Figure 7a). For the metal components, black oil paint was used to prevent corrosion (Figure 7b).

Figure 7a: Painting the frame of the loom with acrylic paint

Figure 7b: Painting metal component with oil paint

The weaving test of the improved traditional loom

Warp preparation or warping: At this stage of the project, long yarns were put together forming the yarns that run lengthwise for weaving. Warping was done on the warping board. For the length of warp to be longer than the measurement required, a surplus of 40 cm was added to allow for shrinkage, tying and wastage as the actual weaving cannot reach the very end of the warp. To arrive at the correct number of warp ends, the reed dent was counted (240 dents) and multiplied by 2. This is because in actual weaving each eye of the reed takes two warp ends. So the number of warp ends required was 480. A strand was tied to a peg and wound round the warping board till it got to the other peg. This forms the passage for the warp yarns to be wound. While winding round the pegs on the warping board, the distance if found to be longer or shorter than the length of the strand, the cross beams carrying the first peg is removed and adjusted to shorten or lengthen the distance.

After securing the required length, the yarns (yellow in colour) were put on a skein winder. Two hanks were fixed to get a 2-strand yarn for the warp. The two ends from the hanks were tied to the first peg. The warping was done winding the yarns round the pegs and along the path of the strand with the hand while the skein released as they were pulled away. The warping was done in an alternating formation so that crosses were formed to help prevent the warp from tangling up during weaving. The crosses were carefully preserved by holding them together with a cord (Figure 8) when removing the warp from the warping board (Figure 10). In removing the warp, the first peg was removed first. After this, the entire length of warp was "chained" by loosely interlacing the entire length of warp with itself. The purpose was to reduce the warp to a convenient length (Figure 9a & 9b).

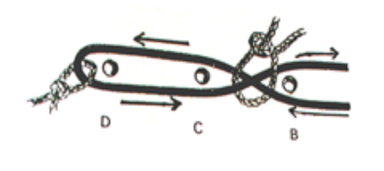

Figure 8: Preserving the crosses

Figure 9a: Beginning posture of the chain stitching process

Figure 9b: The chain stitched warped yarn

Beaming

The next process after warping was beaming. At this stage the "chained" warp was "unchained", that is the "chain" was undone, and the entire length of warp was stretched taut and rolled onto the warp beam of the loom. In the process, two shed sticks were inserted into the warp in the spaces formerly occupied by the pegs, that is, before and after the crosses. The two ends of each of these sticks were tied with thread to prevent them from falling off the warp. The end of the warp was attached through the previously occupied peg to the warp beam. The harnesses were lifted off the weaving area so as to leave it free for the beaming process. The warp was passed through the weaving area to the front of the loom and beyond the front end of the loom and attached to the drag weight (Figure 11). The box was pulled slightly to stretch the warp; the bindings that had been tied initially to secure the crosses and mid sections of the warp were removed.

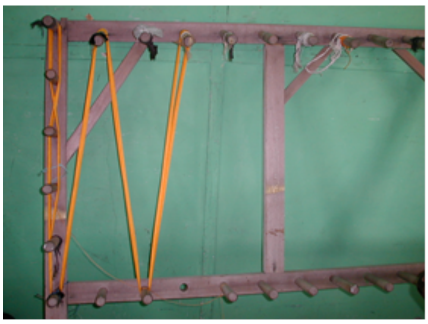

Figure 10: Warping with the warping board

Figure 11: Beaming by the box method originally used as the warping stone (*Tweso*)

A raddle was fixed to the warp beam and the warp spread over it, bearing in mind that every inch of the raddle had three dents. The warp was centred on the raddle and spread out covering only the required width of the fabric to be woven. After spreading out the warp correctly, the cover of the raddle was secured and another shed stick was inserted into the warp sheet right in front of the raddle.

Gently the stick was moved to and fro the warp and finally left at a point close to the drag weight. The next thing was to move the two shed sticks inserted earlier on through the warp to a point close to the raddle, and start the beaming process by turning the warp beam in clockwise direction. This motion collects the warp onto the beam under tension provided by the weighted box (Figure 11). Beaming sticks were inserted into the warp sheet as they rolled onto the beam to redistribute and maintain the tension in the warp. They also prevent the layers of rolled warp from moving into another to cause entanglement while on the beam. The process of rolling the warp onto the beam must be reasonably slow, and under good and critical observation to avoid entanglement and breakages in the warp yarns (Sackey, 1995).

The three shed sticks were carefully pushed slowly through the warp to keep the ends from clinging to one another before being rolled onto the warp beam. Whenever the warp beam is turned, the weighted box also moves and is dragged along till the whole warp has been collected onto the warp beam leaving enough length of warp for the drawing-in process. The two sheds sticks between the raddle and the warp beam were replaced with thick cords and maintained up to the end of the weaving process, while the shed stick in front of the raddle, close to the drag weight, was removed after beaming. The end of the warp was then detached from the weighted box, and any entanglements and loose ends at that point were cut off. The ends of the warp were then tied in small bundles for the next process of heddling (Figure 12a & 12b).

Figure 12a: Beamed warp ready for heddling

Figure 12b: Weaver engaged in the heddling process

Figure 12c: Weaver engaged in the reeding process

Drawing-in (heddling) and reeding

After beaming, the warp ends were passed through the eyes of each heald of each heddle that are suspended between the heddle frames (Figure 12b). A heddling order which will produce the design or weave needed was followed. It is easier for two persons do the heddling, one positioned in front and the other behind the loom. The one behind the loom takes warp yarns and puts them through the eyes of the healds hook presented by the one in front who in turn draws the yarn through the eye or the heald's eye from behind towards the front part (Adu-Akwaboa, 1994; Asmah, 2004). After heddling for a unit design, the warp ends of that unit were tied together in a loose knot in front of the healds so that they do not remove from the eyes of the healds (Figure 12c). After heddling all the yarns, they were then passed through the dents of the reed (Figure 12c).

The reed was fixed to the sley sword and tied to make it firm for the reeding process. With a reed hook, each heddled yarn was threaded through each dent. When a number of the warp yarns had been threaded, they were tied loosely in front of the reed till all of them were threaded through the dent of the reed (Figure 12c). When the reeding was complete, the loose knots were untied and drawn to make the warp taut. They were divided into two halves and one held in each hand. They were passed under the fly rod of the cloth beam apron and brought over and under the two warp sections; then brought over on top of the two sections and tied together in a bow knot. Care was taken to attain and maintain the correct tension for all the warp yarns so that the correct shedding will be achieved (Figure 13a & 13b).

Figure 13a: Taunting the warp sheet to the cloth Roller

Figure 13b: Securing the warps to the cloth roller

Tying-up

This is the tying of the treadles and lams to the heddle frames to facilitate correct opening of the shed for weaving. A strong cord and a switch knot or a non-slip knot was used for tying. Before the tie-up process, it was ensured that all the shafts/heddle frames were levelled. The tie-up cords were of equal length to provide a proper opening of the shed. Table 2 shows the tie-up was worked out of the design to be produced and woven. However, in this four-pedal loom the heddle 1 and 3 were tied to treadle 1; 2 and 4 to treadle 2; 1 and 2 to treadle 3; 3 and 4 to treadle 4 (Asmah, 2004). In tying, the heddle frames were separated from one another and made even or parallel and levelled to provide adequate shedding.

Table 2: Tie-up order

Heddle frames	Treadles
1 and 3	1
2 and 4	2
1 and 2	3
3 and 4	4

Weft preparations

Yarns in hank were fixed onto the skein winder and a spool rack respectively, and wound onto bobbins with the help of a bobbin winder. The number of plies for the weft depends on the design to be produced. However, in this case, two ply yarns were used. In winding onto the bobbin, two ends were drawn and wound onto the bobbin. Two shuttles with two different ply yarns were needed for a fabric with designs. One shuttle, weaves the design and the others bind it. Many bobbins were wound ready for work to facilitate a quick weaving process (Adu-Akwaboa, 1994).

The actual weaving

During the weaving, a treadle was depressed to open the shed; a shuttle containing the weft yarn was thrown through the shed from one side of the loom to the other side (Figure 14a). The reed was used to push the weft close together in order to produce a compact construction. In the case of a plain weave, only one shuttle was used for one colour weave, but for a check weave, two or more shuttles may be used. For a design weave, another shuttle containing another weft as a binder was thrown from the same side of the loom to bind the first weft which had been inserted in the shed to create the design. So a treadling order was followed according to the design to be produced (Adu-Akwaboa, 1994). Before the actual design was woven, a length of plain weave was made to serve as a binder for the fabric and after the required length of the fabric was produced, a length of the plain weave was again woven to bind the end of the fabric (Figure 14b). When a warp yarn broke during weaving, the two pieces were joined together with a weaver's knot or the sailor's knot; which is flat and very secure, before continuing with the weaving operation. To avoid frequent breaking of yarn, a candle stick was rubbed against all the warp sheets prior to the actual weaving.

Broken weft yarns are not supposed to be tied in a knot, but should be joined inside the shed by allowing one end to overlap the other end and then beating up to make the joint firm in the shed. Hanging weft yarns left at the selvedge were tucked into the shed and beaten up. Temporary knots were made with square knot or 'reef' knot which has the tendency to quickly untie by pulling apart the two ends that forms the knot. For a cleaner woven fabric during weaving, care was taken to keep the warp, the weft and the woven fabric clean. Hands were always kept clean during weaving. In the event of a temporary stoppage in the course of weaving, the ratchet wheel was always released to reduce the tension in the warp and the fabric (Figure 14c). After the required length of the fabric was woven, the fabric was cut and removed from the loom by adjusting the ratchet pawl attached to the cloth beam to give way to the reverse turn of the beam to release the cloth for cutting.

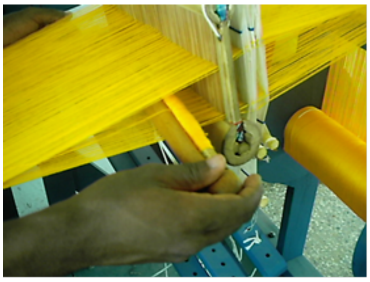

Figure 14a: Created shed ready for weaving

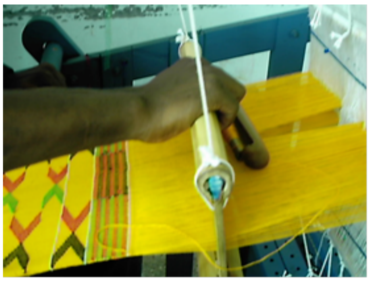

Figure 14b: Weaving in progress ready for the beating up

Figure 14c: Rolling the woven cloth

PROSPECTS OF A NEW LOOM

The constraints to minimize the cost of Kente products lie solely on the usage of well-designed looms, good quality yarns and the dexterity of weavers which becomes the key driving force to reduce the production price of every Kente weaving industry. Developing this new loom definitely enhanced the loom operations and minimized time and operators needed for Kente production. The loom construction centered on addressing the challenges in weaving, which invariably answered a critical market demand to minimize the time, cost and to sustain the global demand for Kente product. The enhanced loom has already shown to be effective and beneficial with few practicing weavers. The loom turns to bring new added-value to Kente production and gives a modest advantage over the traditional ones. The disadvantage of the traditional looms include the weariness of the loom operator, the discontinuity of loom operation that results in inefficiency of the Kente weaving process and the intermittent letting-off of the warp and taking-up of cloth, which affects weaving efficiency and quality of the woven cloth. To alleviate these challenges, the traditional loom was redesigned or modified to make the operations of the loom much easier and faster. This improved the operational features of the loom, by providing a smoother transitional let-off and take-up mechanism needed during weaving (Figure 15a). The introduction of the metal component attached to the beams minimized slippage, wear and tear to facilitate the weaving process (Figure 15b).

Figure 15a: Tautening the warp in the sitting position

Figure 15b: Tautening mechanism displayed in the sitting position

Developmental effort

This let-off and take-up arrangement fitted to the loom helped the intermittent let-off and take-up during weaving by the weaver as normally done with the traditional loom. The introduction of nut-bolt and hook system of adjustment and tightening on both the warp and the cloth beam has reduced the weavers exhaustion (Figure 17). The tension of the warp can be changed as per requirement by simply releasing a crouch knob from the serrated metal disk bolted to the wooden beams fitted to the loom frame (Figure 16a & 16b).

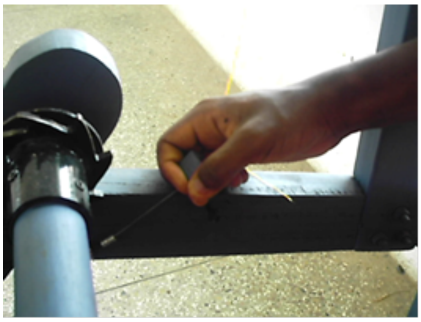

Figure 16a: Unlocking the ratchet wheel

Figure 16b: Relaxing the cloth roller

Figure 17: The complete mechanism

The weaver in a sitting position can engage the operational mechanism in these six weaving steps:

Step 1: In the bid to wind a woven cloth on the cloth roller after weaving, the cable must be pulled, holding the ratchet pawl as the ratchet wheel is released and later secured to lock it (Figure 16a & 16b).

Step 2: The cloth roller is then rotated to wind the woven cloth (Figure 14c).

Step 3: The cable for the ratchet pawl is then unlocked to lock the ratchet wheel to prevent it from rotating in the opposite direction (Figure 16a).

Step 4: To make the warp taut, the mechanism is wound in the direction of the warp beam. This movement is made possible by the direction of the gears on the ratchet wheel as it freely moves in the direction of the winding and does not reverse unless it is unlocked (Figure 15a & 15b).

Step 5: To remove a piece of woven cloth, the ratchet pawl of the warp roller must be adjusted to release it (Figure 15a).

Step 6: To start a weave after a woven cloth, the cloth must be cut and the remaining warp ends re-tied to the roller (Figure 13b).

Observations

The trial run of the enhanced loom was successfully conducted on 50 loom operators. The new loom's development was also subjected to the scrutiny of 40 skilled Kente weavers belonging to a different weaving fraternity in the private or the small weaving entrepreneurs as well as the Bonwire commercial weavers' co-operative and 10 textile students at the weaving studios of the Department of Integrated Rural Art and Industry, Kumasi for the study.

As previously mentioned, a total of 50 weaving operators (40 skilled and 10 students) were involved in this study. Most of them (40 of the operators) were the skilled Kente weavers and 10 of them were the textile students of Department of Integrated Rural Art and Industry. Figure 18 indicated that 80% of operators agreed that the loom has met its said objectives to minimize operations time and is potentially good for mass production. Interestingly, 15% weaving operators advocated that the loom will have the best value in the traditional weaving industry as this type of loom is not available yet in the industry. However, 5% did insist on allowing the loom to undergo further improvements, but agreed with its industrial prospects.

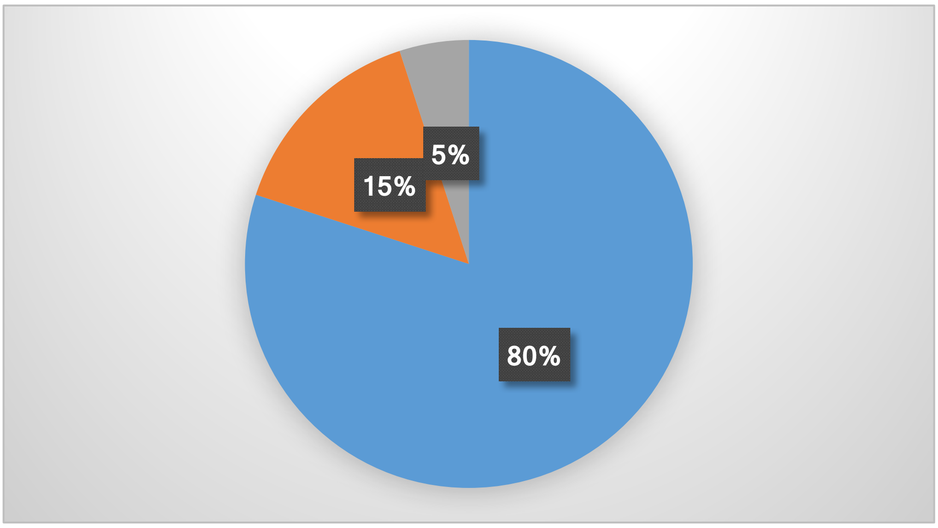

Figure 18: Prospects of the new loom

CONCLUSION

A hand operated traditional Kente weaving loom attached with enhanced features to facilitate weaving was developed. The loom constructed with the assistance of the local artisans consisted of a let-off and a take-up semi-automated mechanism that makes it easier to operate. The loom production was assisted by the consensus of some traditional weavers and expertise of two carpenters. The test fabric produced with the loom was comparatively faster and admirable in its operation and aesthetically pleasing in its visual outlook. The prospect of its construction is potentially good for local consumption due to the availability of its raw materials used, its dismantling and re-assembling features and the technical know-how for mass production. The new version of the traditional Kente loom provides some new facilities that are easy to work with and user friendly. It has the ability to take both the normal 5-inch and the new 12-inch reed. It comes with a rolling mechanism facilitating easy winding of warp and cloth. Hence, this study showed that the new version of the traditional Kente loom will offer great help and relief to all textile institutions engaged in traditional weaving.

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