THE George Alexander FOUNDATION

International Specialised Skills Institute

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Knitting & Spinning: a report on craftsmanship and textile technology in contemporary Japan | Vincent Meyrick, 2023

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- Masaki Sato, Creative Director, Sato Seni Yamagata
- Tesshun Sato, Sato Seni Yamagata
- Syuji Mitsui, Knitwear Department Manager, Sato Seni Yamagata
- Megumi Saito, Chief of Sales Division, Sato Seni Yamagata
- The Fellow’s Parents, Julian Meyrick and Louise McCarthy

Executive Summary

This report details the experience of Vincent Meyrick who was awarded a George Alexander Fellowship to gain further knowledge of knitwear programming and manufacturing in Japan in 2023. The Fellow is a Melbourne-based designer, tailor, and knitwear technician with a passion for craftsmanship and a dream to revitalise the fashion and textile industry. After training in the field for around a year they identified a crucial lack of knitwear knowledge in Australia's young industry professionals. In February 2023 they joined a global knitwear manufacturing hub to further their practice and gain knowledge of the field to disseminate in Australia.

The report covers a two-month internship at Sato Seni, a fourth-generation knitting and spinning mill located in Yamagata prefecture in the regional town of Sagae. Supported by the company, the Fellow worked across a broad range of areas within its vertically-integrated manufacturing and retail facilities. Across six different factories, they studied and practised wool processing, yarn spinning, knitting, dyeing, sewing and product finalisation, regulation, and management. The Fellow also advanced their grasp of the Japanese language and obtained not only an understanding of techniques but the cultural values that are an important part of Sato Seni's successful operation.

The body of the report describes the complex process of knitwear manufacturing from start to finish. There are a number of aspects that can be hard to grasp when considering the knitwear production chain. This report aims to communicate basic information around these processes. It is important for a new generation to have this knowledge in order to implement the closed cycle systems appropriate for a sustainable future in knitwear manufacturing. In the report, only the highlights of the Fellow's findings are provided. An appendix provides an expanded technical breakdown of certain primary elements of production techniques.

In the conclusion to the report, the Fellow makes a number of recommendations arising from his Fellowship experience. After working at Sato Seni, and seeing more of the textile industry in Japan, they identify a number of changes that can be implemented in the Australian textile manufacturing sector around the role and place of a young generation of industry professionals.

The personal impact of the Sato Seni experience on the Fellow was profound. The Fellowship allowed them to study skills needed to be a successful knitwear designer, technician, and production manager, that could not be found in Australia. It provided learnings around organisational practice, vital for the expansion of their own work in future. The Fellow has identified a role for themselves as a mediator between older and younger generations of textile industry professionals. With the Fellow's new understanding of knitwear, they hope to inform and empower others with this knowledge through group discussions and workshops.

Glossary

Sub-contractor: A different factory that is contracted to produce something that is then used or sold by the contracting company.

Cut and Sew (knit): A manufacturing technique in which garments are cut out of knitted fabric and sewn together. This is a quick and cheap way to produce a garment, but it can generate a large amount of waste.

Fully fashioned (knit): A manufacturing technique in which garment panels are knitted to a specific size and shape then sewn, or more commonly linked together. Fully fashioned garments generate less waste, yet they take a long time to manufacture.

Wholegarment TM: Wholegarment is a type of manufacturing invented by the Japanese company, Shima Seiki that knits an entire garment seamlessly. These garments are easy to manufacture in large quantities due to them being entirely produced by a single machine. Although the knitwear programming used to produce them on a computerised knitting machine is both difficult and time consuming. They do not generate waste. Further they eliminate post-knitting construction time.

Cone/bobbin: A conical piece of plastic, wood or metal onto which yarn is wound.

Spindle: A device that sits inside a bobbin or cone and spins it in order to wind on yarn.

Aprons: Rubber mats used to extrude and apply pressure to yarn and slivers.

Combs: Most often a set of rotating fine metal combs aligned horizontally that are drawn through fibres in order to refine them.

Can: A large drum into which slivers are extruded.

Top: Cleaned, carded, and combed wool.

Gilling or Pre-spinning: The process of refining and re-combing woollen top in a specialised machine.

Sliver: A long-extruded piece of fluffy wool that is yet to be spun. An in-between stage, after top making yet before spinning.

Spinning: The process of spinning a sliver into yarn.

End: A term used to refer to the number of yarns used in spinning or knitting. For example, the process of Tri-spin uses three ends.

Aims of the Fellowship

The Fellowship provided the opportunity to become part of a thriving knitwear industry in Japan, and to examine the drivers of its success and sustainability. It provided the opportunity to learn a wide range of industry skills and new technology-related practices.

Most particularly, the Fellow,

- Learnt how to manufacture yarn and knitted garments from start to finish in a closed cycle system.
- Gained insight into the principles and workplace practices that drive a company implementing a successful closed cycle system.
- Gained understanding of knitwear programming and manufacturing.
- Accumulated technical knowledge of the manufacturing chain.
- Investigated the role, place and training of young industry professionals in considering the future needs of the textile industry in Australia.

About the Fellow

Vincent Meyrick is a 20-year-old tailor and knitwear technician based in Melbourne. They have been passionate about clothing and textiles from a young age and since a homestay in Hiroshima in 2016 has had a close relationship with Japan, its language and culture of craftsmanship.

After spending their teenage years learning patternmaking, for 12 months prior to the taking up the Fellowship, the Fellow worked as a knitwear technician in Melbourne. They trained in a knitwear studio developing fashion garments, as well as in industry applied textiles. As a young industry professional themselves, the Fellow prioritises the learning of practical skills in considering the current challenges facing the Australian textile industry.

Midway through the year in 2022, an opportunity to travel to Japan and work as an intern at one of its largest knitting mills arose. Shortly After producing and presenting their first Fashion collection of 2022, the year after in 2023 the Fellow set out to broaden their horizons and gain new skills in the overseas industries. The Fellow travelled to Japan with the dream of one day re-invigorating the textile industry of Australia.

Although the Fellow's industry experience is necessarily limited, their observations about the role, place and training of younger industry professionals, and how to communicate with them are, they believe, vital. The Fellow believes the findings obtained from observing the Japanese textile industry could be successfully applied to be our own in Australia.

Fellowship background

My background and context

The Fellow is a Melbourne-based designer, tailor, and knitwear technician. They have a passion for craftsmanship and a dream to revitalise the fashion and textile industry in Australia. They was awarded the George Alexander Fellowship to gain further experience and knowledge of knitwear programming and manufacturing. In February 2023 they travelled to a far north prefecture of Japan, a small town called Sagae, located in Yamagata. They worked for two months at one of Japan's largest knitting factories.

While in high school, the Fellow trained at a tailor's and undertook pattern-making classes. In 2022, They were introduced to knitwear programming by Patricia Chircop at the company KNOVUS. She encouraged them to apply for the Fellowship.

At this time, the Fellow met Tesshun Sato. Tesshun is the fifth generation of a family of Japanese knitters and the son of Masaki Sato, the current president of Sato Seni, a leader in Japan's knitwear industry. Tesshun organised a diverse and inclusive internship program for the Fellow. Few people get the opportunity to experience every department of a knitwear production company. Before this internship, the Fellow was not aware of the scale of Sato Seni. When they arrived in Sagae, they had little idea what was in store for them.

The Fellow's busy schedule was organised by Tesshun. The Fellow officially worked from 8am to 5pm every day, but their enthusiasm to learn more about knitwear led them to further study most evenings.

By the end of two months, the Fellow was able to speak Japanese in a workplace context. The Fellow studied Japanese throughout high school and completed a homestay in Japan in 2017. The complexity of the Japanese language made it hard to achieve fluency. As well as the challenges of understanding company protocols and their daily tasks, learning knitwear programming in Japanese added another layer of difficulty to the Fellow's internship. Japanese workplace culture is unique and can be confusing at times. There was an amount of formal language that they had to learn quickly in order to be able to communicate respectfully at work.

As well as workplace challenges the Fellow faced a number of personal issues, such as the problem of making friends in a foreign country, and the homesickness young travellers naturally experience. Thanks to the kindness and generosity of the people they met, the Fellow was able to overcome these challenges, and not only learn a great deal about knitwear, but make important industry connections and new personal relationships. The company recognised the Fellows keenness for new knowledge and staff went to great lengths to instruct them. For the first month they worked with a mentor most nights, receiving lessons in knitwear programming, and using the company's machines and yarns to create thier own personal learning projects. The Fellow's questioning and

documentation of work processes were welcomed. Staff said they felt invigorated by the Fellow's passion and interest in all things knitwear. The Fellow was also accepted socially. They lived in a company apartment and regularly attended company functions with heads of departments. The Fellow lived like any other employee of the company and experienced every facet of Sato Seni and its knitwear production techniques.

History of Sato Seni

Sato Seni is a fourth-generation knitting and spinning mill located in Yamagata prefecture in the town Sagae. Sato Seni was established in 1932 (the 7th year of the Showa Era) by the great grandfather of the current company president, Masaki Sato. In 2021, Tesshun Sato began working at the company, continuing the family tradition. The company's name stems from the family name Sato and the word for fibre in Japanese, Seni; so roughly "Sato family's yarn". The company originally hand spun woollen yarns for weaving. In 1954, it became a manufacturer of worsted wools. In 1973, the current yarn spinning factory, Miizumi Factory, was opened. In 1992 under the direction of Masaki Sato, the factory transitioned away from being a subcontractor. It developed a thin mohair fibre that was half the width of what the industry previously believed possible. In 2007, after launching several new brands Masaki Sato exhibited at the world-famous exhibition, Pitti Filati. The company's yarns are now used by firms such as Chanel and Balenciaga. In 2009, Sato Seni's mohair fibre was used by Nina Ricci to make Michelle Obama's sweater for Barack Obama's presidential inauguration. Today, the company has around 230 employees and works across 7 different factories. This includes its head office and knit factory, the wholegarment factory, the logistics office, the small- and large-scale spinning factories and the dyeing factory. There are showrooms in Tokyo and New York that stock its clothing and other high fashion items. Sato Seni's markets are extensive. The brand is closely connected with many subcontractors making circular knits and woven textiles. Furthermore, Masaki Sato is the president of the world-famous Bunka fashion college alumni group. Due to his charisma and work ethic, the company has made extensive connections around the world and in Japan. It is one of the first textile companies to their design and manufacturing process into a brand identity that combined factory and designer label. Before Masaki Sato, many people in Japan believed that design houses were of higher value than those of manufacturers or subcontractors. Masaki Sato shifted that narrative to where it is today.

Impact

Personal

The personal impact of the Sato Seni experience on the Fellow was profound. It was instructive on many levels, including the Fellow's skillset and his cultural understanding. The techniques they learnt in Japan have provided them with a new understanding of knitwear manufacturing that will allow the Fellow to make innovations as an industry practitioner in Australia. It gave them insight into the textile sector that will be a strong foundation for the rest of their career. Seeing a successful, vertically integrated knitwear company in Japan, has given the Fellow a blueprint for a similar Australian company. The dedication of the workforce at Sato Seni made a strong impression on the Fellow, inspiring them to pursue their craft with greater clarity and purpose.

After living and working for four months in Japan the Fellow also gained greater fluency in speaking Japanese. This has allowed them to understand knitwear's more technical aspects as well as build personal connections in the Japanese textile sector. Their experiences at Sato Seni provided them with a network of new industry contacts and will impact their career for years to come. The friendships they made while in Japan broadened his sense of community and his understanding of a unique national culture.

Professional Impact

The Fellowship allowed the Fellow to study the skills needed to be a successful knitwear designer and technician. The techniques, machines, and tools that the Fellow learnt to use means they are now equipped to perform a range of jobs in a textile manufacturing company. These new skills both enhance their employability as an industry professional, and better position them to contribute innovative knitwear ideas. The Fellow now has the ability to design and make cutting-edge, handcrafted garments. The new knowledge they have gained about the manufacturing supply chain in Japan puts them in a strong position to inform the development of the knitwear industry in Australia. Learning about the ways in which a well-organised Japanese company works has helped the Fellow make their own professional practice more streamlined and efficient. The Fellow is now in a position to assist Australian professionals to do likewise.

As well learning about the workplace culture of Sato Seni, the Fellowship has developed the Fellow's ideas around the effective sharing of professional skills. Seeing how the dissemination of information is a key factor contributing to the success of Sato Seni has encouraged the Fellow to incorporate the passing on of skills into their journey as an emerging professional.

Organisational Impact

Although the Fellow is currently a sole-trader, the learnings around organisational practice the Fellowship provided will be vital for the expansion of their work in future. The structure and operation of Sato Seni is an example of one of the best ways in which a knitwear company can operate. There were many aspects to Sato Seni's organisation that the Fellow found instructive. For example, clear workplace roles, dedication to one's job driven by leadership encouragement, respect for senior staff and effective task delegation were key organisational practices. Documentation played an important role in the smooth operation of the production line and in the daily life of the Fellow. The methods of documentation used in Japan can be transferred to the Fellow's own practice. Witnessing the positive impact that an encouraging leader can have on staff has prompted the Fellow to consider how their own motivating role is vital to the success of their organisation.

Broader sectoral impacts

As a result of the Fellowship, the Fellow has received training in a range of practices in knitwear manufacturing. They are now in a position to potentially contribute to different workplaces and implement new organisational principles. Previously, the Fellow had limited experience in sewing and knitwear. They now have the ability to share ideas around top making, a variety of spinning techniques, and dyeing.

Crucially, the Fellow has identified a new role for themselves as a mediator between older and younger generations of industry professionals. The respectful and purposeful relations between younger and older staff at companies like Sato Seni are of great benefit to the broader Japanese knitting sector. The Fellow is inspired to encourage similar relationships in the Australian knitting sector. Key to this is establishing a connection between apprentice practitioners and experienced senior mentors. The Fellow hopes to contribute to this by explaining Sato Seni's production process in a way that appeals to young people considering their place within the textile industry.

The Fellow's experience across all aspects of production at Sato Seni showed them the factors that contribute to effective and responsible clothing production. New insights into the overseeing and management of production processes is another sectoral impact. Creating greater awareness about the importance of the dissemination of information in the workplace, and the role of leadership, is third sectoral impact.

Fellowship learnings

Appendices

In an Appendix to this report, the Fellow outlines the technical details of their findings. There are a number of things that can be hard to grasp when considering the knitwear production chain, yet it is vital to understand them in order to implement the closed cycle systems appropriate for a sustainable future. Here, only the main aspects of the Fellow's findings are provided. An appendix will provide all information in addition to an expanded technical breakdown of certain primary elements of production techniques. These expanded explanations may be useful to any people looking to enter the workplace or further their view on textile production. When reading this document, it is important to understand that these processes are constantly changing and being done in different orders to achieve different results.

The Appendix is the long format version of fellowship learnings section of the report and is contained at the end of the report.

Head office 本社

Sato Seni's main office and factory

The heart of Sato Seni is its head office, where the company president works, and the first knitting mill is based. Sato Seni is unique in that its company brand symbolises both individual designs and an artisanal factory. This is Masaki's dual creative vison. Masaki's ideas drive the company today and many aspects of Sato Seni are directly overseen by him on a daily basis. Head office contains the sales, design and planning, knitting, pattern making, sampling, cutting, linking, sewing, steam set, product check, and packaging departments. It has a small dispatch team and a large lunchroom.

Figure 1. The front of head office

Knitting mill 2.0 第二工場

Sato Seni's whole garment factory

The second knitting factory specialises in WHOLEGARMENT TM manufacturing. This factory specialises in fine gauge technical knitting that is zero waste and seamless. It is different from the first factory for a number of reasons. First, as Shima Seiki WHOLEGARMENT TM knitting machines are state of the art and a valuable asset of Sato Seni, the factory has a corresponding level of security and secrecy around it. Second, although the factory has 150 machines it only has 14 technicians operating the entire facility. These technicians are highly trained and have close connection with the Shima Seiki company. The standards of this small team are of the highest kind, and their goals are qualitatively different from the knitting team at head office.

Yamagata Finishing and Dyeing 山形整染

Sato Seni's dyeing factory

Yamagata finishing and dyeing is a large dyeing and washing factory located in the foothills of Sagae. Unlike the other factories it was not created by Sato Seni but was acquired from an old managing company. Previous to Sato Seni the factory faced numerous issues. After Sato Seni's restructure, the company has blossomed into a smoothly running and profitable business.

Figure 2. Tesshun at the dyeing factory

Mizumi Factory 三泉工場

Sato Seni's artisanal yarn spinning factory

Mizumi Factory is one of two wool processing and yarn spinning Factories. It produces intricate and artisanal yarns on a small to medium scale. It has a wider range of departments for dealing with different wools. It is located next to the Sagae River and surrounded by cherry tree farms.

Figure 3. The long Mizumi factory and some patches of farm beside it

Top Making Factory

Sato Seni's offshore top making factory

Sato Seni, like almost all yarn spinning factories outside of China, does not produce its own top. It purchases its top from a factory in China that scours, cards and combs raw wool from around the world. However, outlining the process is key to understanding the complete knitwear production chain.

Scouring and carbonizing (offshore)

Scouring is the process of washing dirty wool after it has been shorn from the animal. Wool contains a large amount of grease, dirt and vegetable matter that needs to be removed before it can be further purified through the carding and combing process. Scouring was once just a thorough

washing but in modern times it uses chemicals to efficiently eliminate all impurities trapped in the wool.

As it is done off-shore in China, the scouring process uses acids and chemicals. Japan, like most other countries, buys its pre-scoured wool from China. Sato Seni investigated establishing their own scouring plant but discovered it only became profitable on a very large scale. In China, the process also produces unwanted chemical run-off. Sato Seni, believe it would be beneficial to complete more scouring in Australia, where its environmental impacts can be much better controlled and effectively eliminated

Carding and combing (offshore)

After the wool has been scoured it is clean, yet still in a relatively raw form of fluffy woollen clumps. These are carded so that short fibres are separated and extracted from the desired longer ones. The industrial carding process makes use of a system of vertically stacked tubular brushes. These brushes are essentially like hairbrushes untangling the wool and getting rid of contaminates. The carding process extrudes brushed wool into a sliver around four to six centimetres in diameter. This is wound up on itself like a giant ball of wool to be transported to the combing machine.

The woollen slivers are convergently fed into the combing machine. The combing machine uses a large set of metal teeth to align the fibres. It spreads the wool fibres, puts them through a comb then runs them through a fine-toothed brush that systematically lays the brushed pieces together. Then these are extruded and balled up again for transportation.

It is important to note that Sato Seni also had a combing machine that they use to recomb fibres they have purchased. This is essential when producing worsted yarns, as wools that have not been combed remain woollen yarns.

Figure 4. Sato Seni's carding machine used for refinement

Mizumi Factory: Pre-Spinning

Pre-spinning process or gilling

Gilling is the process of taking a rough ball of wool called a head and combing it until it can be extruded into a fine sliver before it is spun. The combing, rolling and pulling that is needed to gill wool is done by a number of different machines. It can sometimes be hard to discern the specific purposes of these different machines. Therefore, a brief explanation is useful. A gilling machine is any machine used after carding or combing that purifies the wool. They are all machines with an entry port that the wool sliver is fed into. The wool passes through a roller and comb and an extruder spirals out the wool into a can (see Appendix section 1.1).

Figure 5. View of inside Mizumi factory from overhead

Mixing

The mixer splices different heads of wool together, allowing the blending of different fibres or colours (for example, an alpaca and wool blend or an Acrylic and mohair blend). It utilises special rollers to first unwind the heads of wool that have come from combing. It then sprays a small amount of oil on half of the wool as it splices the heads together, re-hydrating them before the rest of the gilling and spinning process. The liquid spray is important in reducing static electricity and aiding the spinning process. After the wool is sprayed and spliced, it is sent through a set of combs and extruded into a can.

Figure 6. Mixing machine from the back and front. Intake rollers and splicing trays

Leveling

The leveller allows precise control of the wool's thickness and density. It contains a set of rollers and combs, but it also utilises an extremely powerful set of rollers that not only controls the draft precisely but contains a measuring device to detect the wool's texture and density down to the micron. It also has a knot spreader.

Figure 7. Leveller side profile, intake rollers and knot spreader

High speed gilling

The highspeed giller is essentially a thorough and ultra-fast combing machine that serves to further align the woollen fibres. It is integral to achieving high-quality yarns. Using the technique of doubling, many cans of yarn are converted into a very fine quality of fibre.

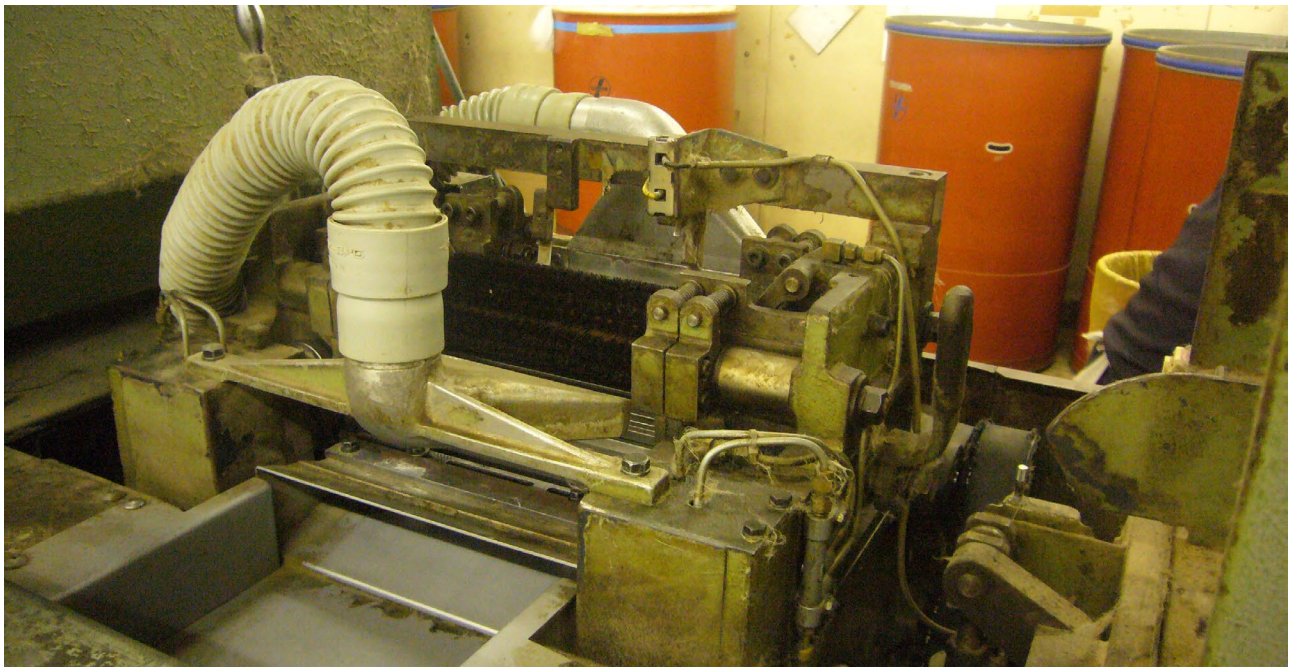

Figure 8. Combing box that contains rows of combing needles of the High-speed Giller

Bi-coiler

The bi-coiler rolls and combs the sliver and also coils the yarn into two different slivers in one can, the two coils winding in opposite directions. This means they can be uncoiled easily and wound onto a cone. This machine extrudes into two cans simultaneously i.e. it extrudes four ends of sliver.

Figure 9. The twin cans of the Bi-coiler

Rubber

The rubber is generally only used in the processing of tricky to spin yarns. It takes in bi-coiled yarns and rubs them between a set of aprons to slightly strengthen and extrude the yarn. It is an extra step to lower breakages during the finishing and spinning process ahead.

Figure 10. The numerous cans being fed into the rubber and its quad output

Finisher

The finisher is the first time the fibre is wound onto a cone. It takes the two ends from a bi-coiled can and feeds them into a small set of twin rubbing mats (aprons) that add a final amount of twist and density before being fed through a twin winder that lays the two ends side by side on the same cone. It is important to keep in mind that the other machines refine the fibre but do not strengthen the sliver. The rubber and the finisher add the body the sliver needs before being wound onto a cone.

Figure 11. The finisher winding on

U% measurer

The U% measurer is a measuring device utilised after every stage of the gilling process. It is a machine in which a woollen sliver is fed through two metal rods to measure the density and evenness of the wool. Every time a minute difference is detected in the woollen sliver a meter ticks higher. The higher the meter reading, the more uneven the woollen sliver. This machine helps craftsmen slowly track the refinement of woollen slivers.

Figure 12. Measuring devices of old and new

Mizumi Factory: Spinning

Spinning

Spinning is the process of turning a sliver of wool into a yarn. The slivers that have previously been refined in the gilling process are now turned into yarn using special machines. These machines all harness the same basic dynamics of twisting and pulling of hand yarn spinning. There are a range of machines that create different yarn. Sato Seni mainly use two different types: ring spin which is used for making standard knitting and weaving yarns; and trispin which is used to make artisanal and creative yarns for diverse design applications.

Figure 13. The many heads of spindles and heads of wool on a ring spin machine

Ring spin

Ring spin is one of most common types of industrial yarn production techniques. It is a type of bobbin spinning that derives its name from the two rings that are around every spindle on the machine. Any ring spinning machine has four essential elements. Firstly, a cradle that is a metal frame that bobbins of woollen sliver can hang from in mass. Secondly, a spinning bobbin that sits at the bottom of the machine. This is what the yarn is spun onto. Thirdly, small rollers and aprons that take the sliver from the cradle and extrude it on top of the bobbin as it spins. Fourthly, it is sent through a set of rings that surround the spinning bobbin that twist the sliver at high speeds to form a yarn (see Appendix section 1.2.)

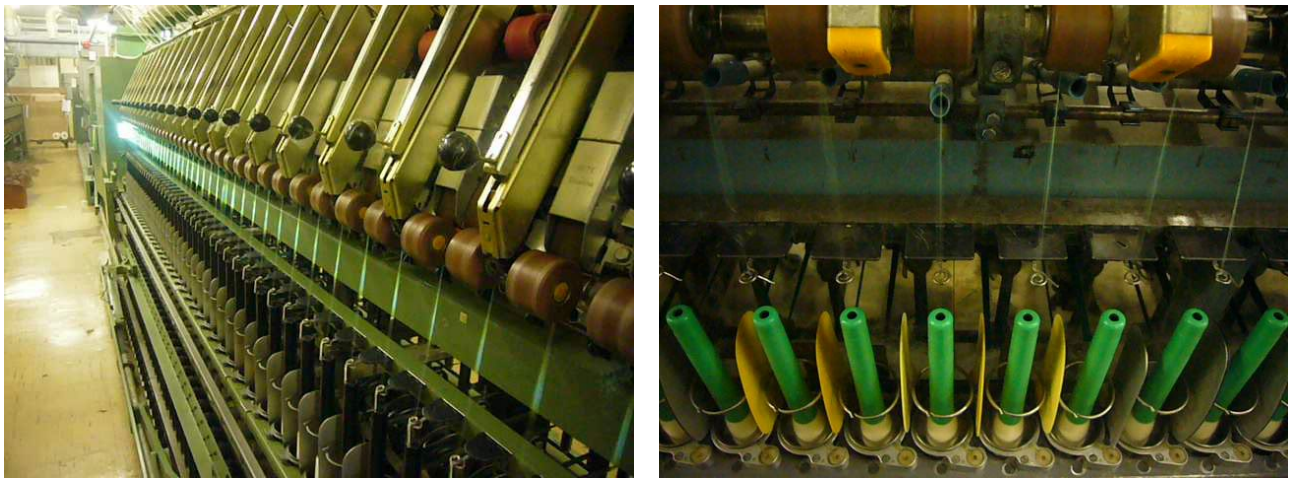

Figure 14. Close up of the woollen yarn being twisted and the bobbin sitting on the spindle

Ring spin: knitted yarns

The ring spin process can be used to create either weaving or knitting yarns. However, with knitting yarns a number of factors need to be changed. Knitting yarns are thicker and less dense than weaving yarns. They are much larger in comparison. Therefore, the machines used to make knitting yarns are bigger. They are exactly like a ring spin machine but on a larger scale. The sliver that is fed through the machine is also larger.

Figure 15. The chunkier knitting yarn ring spin machines

Trispin (loop yarn)

Tri-spin (sometimes called yarn twisting or “fancy yarn making”) is an Italian invention that twist three, single-ply yarns into one. It is also one of the most difficult spinning machines to maintain and use as it has three times the number of moving parts of a normal spinning machine. The Sato Seni staff who work on these machines are all highly trained, with slightly different specialities. According to the fellows account, even after a year of working on them every day, one still cannot

understand everything the machines do. The staff person in charge had been working the machine for ten years and said every day presents new challenges (see Appendix section 1.3).

Figure 16. Various tri-spin yarns

No supplementary photos around Tri-spin were included due to the secrecy of the machines and techniques used at Sato Seni.

Cone winding

Cone winding is a vital transitional process for making yarn. It can be easy to overlook. It involves getting the smaller plastic bobbins on which the yarn is initially wound and re-winding it onto a cardboard cone appropriate for selling or twisting. The machines that rewind the smaller bobbins onto a cone are entirely automated but must be manually operated to fix errors or when a new larger cone to wind onto is being introduced. The small plastic bobbins used by a spinning machine are wound individually onto a larger cardboard cone by this machine. A cone for knitting might contain around 10-20 smaller bobbins (see Appendix section 1.4).

Figure 17. The winding machines

Steam set

High twist yarns such as mohair, created on a ring spin machine, are steamed to lock in their twist. A Z-twist yarn that has been spun anti-clockwise needs to be stabilised before twisting it into a two-ply yarn. Some yarns that are very fluffy need to be shrunk before there are knitted. The wound bobbins that come from the spinning machines are loaded into a large crate and sent into a pressurised steaming chamber where they are steamed to achieve the shrinkage or the consistent twist desired. If a yarn is not properly steamed it can cause a garment to twist after knitting, or shrink too much during the steam set process.

Figure 18. The steaming chamber that large crates of bobbins are put into after spinning

Twisting

Sato Seni's twisting facility is outsourced to a small-scale company. At the time of writing this report, Sato Seni is their only contractor. The twisting factory is about the size of a large domestic home, and only contains twisting machines. The yarn twisting process takes two pre-spun single-ply yarns each with either a Z or S twist and twists them together. This cancels out the yarn twists and makes them into a stable two-ply yarn. This ensures the yarn does not twist after the garment has been knitted or woven. It also ensures the desired thickness of yarn is achieved. Similar to the ring spin machines, first two single-ply yarns are wound onto a two-ply bobbin. This untwisted two-ply yarn is then fed through a twisting machine that uses a set of spinning hooks to twist the yarn and feed it onto a cone. The yarn has now been twisted. Sometimes it is then steamed again to lock in its twist.

Figure 19. The twisting machines

Dyeing

The dyeing process contains two parts, the testing phase and then the dyeing phase. Dye testing is extremely important in order to achieve consistent dyeing results. Different fibres call for different dye's chemicals and treatments. A blended fibre may need to be dyed twice with two different chemicals in order to achieve one colour, or the second dye may need to be chosen in order to not affect the previous dye colour. This testing room is a laboratory that contains chemicals, scientific testing tools and recipes developed by dyeing craftspeople. From this, two different types of dyeing occur, cheese or hank dyeing (see Appendix section 1.5).

Figure 20. Left, cheese dyeing. Right, hank dyeing

Hanking

Hanking is the process of winding yarn into a large circular loop. It has no cone and is a bundled-up circular pile of yarn. Hanks are ideal for dyeing as they can be hung from rails in a special hank dyeing machine. Hanking uses specialised machines to wind the yarn off the previous cardboard cone and onto a spinning wire frame that the hank can eventually be removed from. Hanking is another easily-overlooked yet integral part of the yarn making process like twisting. These types of specialised jobs are often undertaken by contractors. Sato Seni is investigating producing its own hanking division through the buying out of an existing hanking factory.

Figure 21. A closer look at the hanks, hanging on rails in the dye vat.

Yarn Storage

A place to store and classify the yarn produced before it is used or sold is crucial. Sato Seni has a yarn bank for its technicians to use for production and sampling. This contains a wide variety of yarns that can be drawn on to create new garments and knitted textures. It is a large four-story warehouse to pack and store yarn before sale across the world. The careful storage of yarn ensures it can be readily accessed and shipped in a timely and orderly fashion.

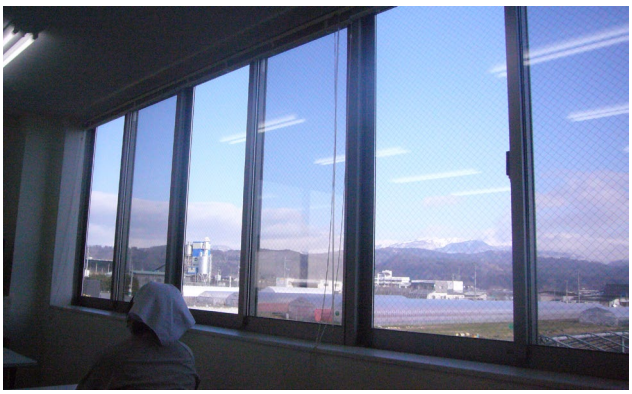

Figure 22. The lunch room at Mizumi Factory

Head office: ground floor

Design and planning

Sato Seni's design department, like many design studios in Japan, leans towards planning with the application of design thinking. It is consumer driven. The design team work closely with the sales team. Data on sold garments and popular models are regularly given to the design department. All designs have to be approved by creative director Masaki Sato. Another truly unique aspect of the design team is that some staff actually started as knitwear technicians or sales analysts so many of them are able to make market-informed judgments. Some designers work directly on their own samples. The communication across departments leads to thoughtful design creations (see Appendix section 1.6).

Sales 営業

Sales is a broad term used for an extremely large department of Sato Seni in charge all ingoing, outgoing and internal orders, made by both customers and employees. There are a few sub sections of the department that address different aspects of sales and ordering. Sales is key to Sato Seni's operation, and a driving force of the company. The sales team are not just located in Yamagata but in Osaka and Tokyo because of Sato Seni's popularity across Japan (see Appendix section 1.7).

Head office: production upstairs

Pattern making パタン

Pattern making is the starting point of any textile production process, although the role of the pattern maker at a knitwear company has some key differences in comparison with one that does not have such a specialisation. In Sato Seni there are three to four pattern makers: one or two trainees, a senior employee and the head of department (see Appendix section 1.8).

Sampling

The sampling team is highly skilled. It is comprised of eight veteran employees with broad knowledge and experience. They produce between 80 to 100 garments in any two-month period. They employ different manufacturing techniques to produce a diverse range of products, as well as fit and modify them. They develop a product and provide instructions to the production team to manufacture it at a consistent quality.

Knit production

Sato Seni employees a fleet of approximately 250 Shima Seiki knitting machines that utilise a type of highly technical visual programming, called Knitwear Paint TM, to produce a wide range of

knitwear. This program is part of a range of programs and machines developed by the Japanese company called Shima Seiki. Shima Seiki is one of the largest knitting machine companies in the world and their head office resides in Wakayama, Japan. They not only manufacture the knitting machine but also produce knitwear, train customers, have teams of designer and programmers experimenting around knit and also have museum centred around the history and methodology of the company.

Sato Seni's knitwear production is the heart of the company. It manufactures many different kinds of garments using a variety of techniques. Though Sato Seni sometimes produces textiles for other companies, its label has a distinct market status due to the high importance it places on craft skills. There is a considerable range of old-school and state of the art knitwear programming and manufacturing techniques employed across two different factories.

Sato Seni batch manufacturing business model allows the skilled knitwear craftsperson to be a part of a garment's full creation cycle. Considerable communication between departments takes place during the making of a knitted garment. The knitwear technician is expected to produce the knitted pieces from start to finish. This allows the company to produce high quality artisanal knits that have been shaped by the knitwear technician's original vision for the garment.

Two main types of garments are made at the main factory:

1. Cut and sew, this is to be knitted and cut out by the cutting team.
2. Fully fashioned, these are knitted panels intended to be linked together by the linking team.

(See appendix section 1.9).

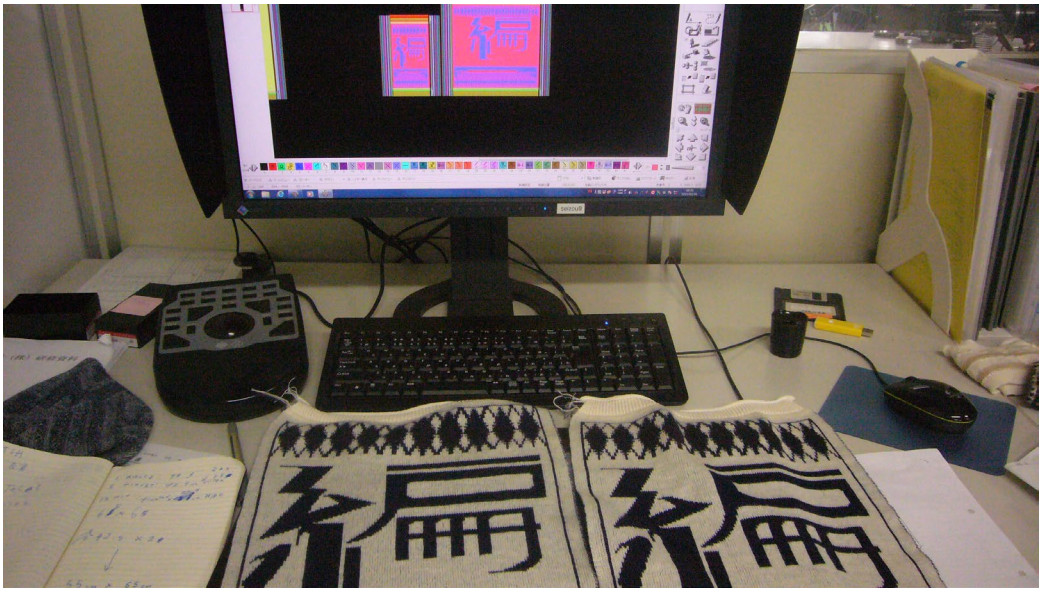

Figure 23. The Fellow using KNIT PAINT TM to develop a small jacquard swatch

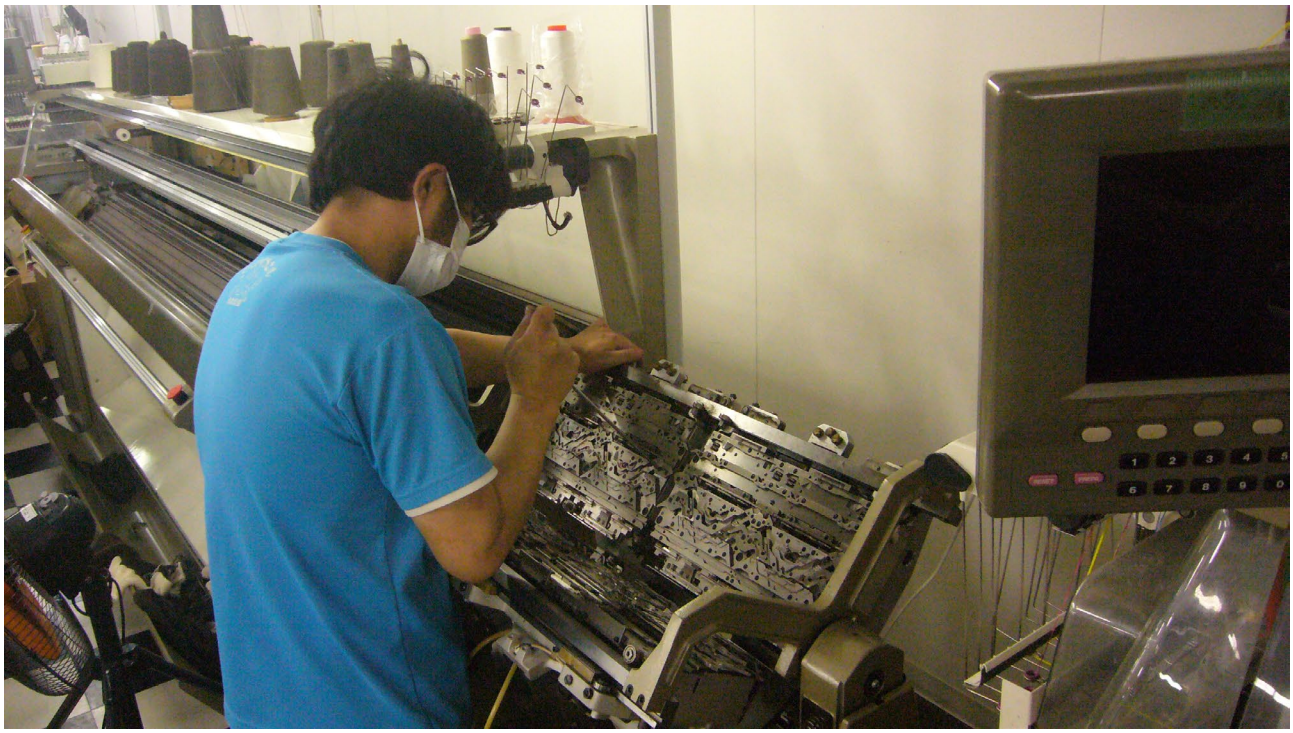

Figure 24. A knitting machine carriage hat has been turned upside down during repair

Figure 25. A look at the fleet of knitting machines at head office

Knitting mill 2.0

Wholegarment Manufacturing

Sato Seni produces WHOLEGARMENT TM knitwear for themselves and other companies. WHOLEGARMENT TM pieces are characterised as having no seams and being completely knitted on a single machine. These garments produce no waste. They are expensive to develop in small numbers but become cost effective to manufacture on a large scale. Due to this fact they are increasingly popular with established large scale fashion brands. As well as being cost effective and waste free, the varieties and application of WHOLEGARMENT TM knitwear are endless. The technology is used by NASA, medical companies, and haute couture fashion houses alike. Different silhouettes and 3-dimensional shapes can be created on the single machine using a single knitwear program. However, this means programming WHOLEGARMENT TM knitwear can be labour intensive. Sampling often takes weeks and uses considerable materials and resources. Furthermore, the newer machines that utilise WHOLEGARMENT TM technology require years of training to be able to write their specific programming. WHOLEGARMENT TM knitwear technicians need to have highly specific skills to fix and maintain these machines. Often Shima Seiki is called on to help with these tasks. (see Appendix section 2.0).

Yamagata Finishing and Dyeing

Washing

Figure 26. Industrial scale dyers

Washing is a tool to control aspects of the garment throughout the manufacturing process. It takes place at the dyeing factory which has facilities for both washing and drying. The act of washing and drying a knitted garment can be utilised to shrink it. It is an integral step to creating a stable garment that will retain its size and not stretch. This shrinkage can be harnessed in a number of ways as a design element. For example, the same scarf can have a completely different feel depending on the wash and dry times used. Generally, a scarf will get denser and smaller as it is put through the washing process. If a garment is knitted with a thin yarn at a low gauge, it can be shrunk down to a higher gauge. A knit that has not been pre-shrunk can quickly stretch and then over-shrink in the drying process (see Appendix section 2.1).

Garment Dyeing

Dyeing a whole garment at Sato Seni is not regularly done. Usually, yarns are dyed before they are spun, yet garment dyeing may be implemented to give a particular unique design feature to a garment or to rectify a mistake. When dyeing a finished garment, it can be difficult to achieve an even look. Yet some of the time an uneven garment dye finish is a mark of craftsmanship and may be used as a design feature.

Head office: production downstairs

Linking

The machines used for linking is a type of specialised chain stitch applied by a linking machine that can sew knit seams together while still maintaining their stretch. It is a difficult skill that not only takes years to master but is very specific. At Sato Seni they value linking over wholegarment cutting and sewing, as the labour hours and craftsmanship that go into linked garments make them highly desirable. Linked seams stretch and bend, unlike a normal flat sewn seam (see Appendix

Figure 27. A vast array of linkers

section 2.2).

Cutting

The cutting team oversee all the cutting and sewing of garments at Sato Seni. This department works across a range of cutting tables, systematically lining up their design graphics and then

cutting them out with scissors or electric rotary blades by hand. The reason for this approach to cutting is that complicated knit designs have slight variations due to stretching when being knitted. This means they cannot be layed up and cut with a programed cutting machine as it would make a differential product. Therefore, they are stacked, aligned and cut out with precision by hand.

The other side of the team was the computerised cutting machine. Headed by only two people. This very large machine cuts out woven materials. The machine used was called a Shima Seiki P-CAM it ran on the same programming for pattern development which allowed lays to be drafted and then sent over to the machine to be cut. This automated machine was extremely precise and efficient.

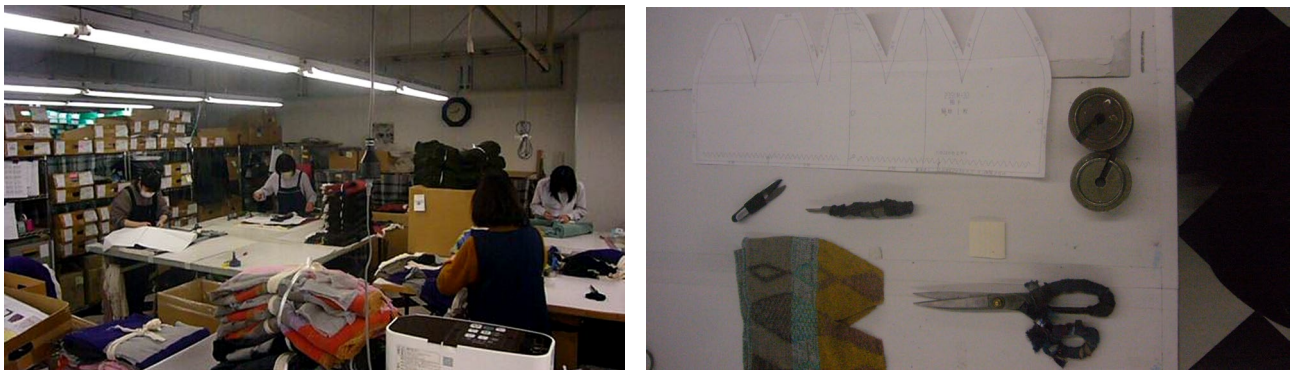

Figure 28. The cutting team at their tables, the cutting person's tools

Sewing

Sato Seni's sewing room is capacious and well-equipped. Its sewing team is the largest department in the whole company. Many staff are trained on the job, while some come from fashion colleges. They are talented machine sewers with the ability to produce a range of Sato Seni garments. Jobs are given to machinists in boxes, and contain all the documents and materials necessary for their construction. Each garment is assembled from start to finish by one technician.

Figure 29. The machine room

Steam Setting

Steam Set is a key aspect of knitting. It is often very undervalued from an outsider perspective. Steam gives garments their final finished form and allows them to stay that way. Knits stretch and are often get crumpled when they first come off the machine so steaming is vital to producing a marketable product. The Sato Seni steam room is around 40 square metres with a humid environment. There are five steam beds, each with a corresponding table behind them. There is a boiler in a back room as well as washing machines and a dryer for sampling. Hanging on the walls are wire frames and rulers (see Appendix section 2.3).

Figure 30. The steam beds and the wire steam set frames

Head office: product finalisation

Packaging & Product checking

Sato Seni considers every aspect of the company important. The staff who run the packing and product checking departments work with passion and diligence. Constantly considering new techniques and methods, the team is as craft-conscious as any other department. To produce and sell a successful garment, all aspects of it must be considered. Some members of these departments have been with the company for over thirty years. Packaging is the last process that happens at the factory. It is extremely fast paced (see Appendix section 2.4).

Figure 31. The Packaging & Product checking department and cone lamp

Knit Repairs and Inking

Garment control often leads to finding defects in garments and this leads to having to repair them. The company does not tolerate waste, so everything must be repaired. Despite the focus on skill and quality, defects are an inevitable part of the manufacturing production chain. When a flaw is found there Sato Seni have a team of people to fix the defects to the company's high standards. (see Appendix section 2.5).

Figure 32. Repairing tools; snips and a machine needle for tucking in stiches

Select Retail Store

Another unique aspect of the Sato Seni franchise, and a contributor to its current success is the retail store located close to head office. This select store is named GEA, after the gears found in a gilling machines. A high-end shop, it stocks all of Sato Seni's brands, such as M&Kyoko, 991, Fugafuga as well as pieces that other brands had produced through Sato Seni. There are also innovative and popular brands like Maison Margiela and Comme des Garcons. The clothing for sale is curated by the shop manager. This collection of cool and interesting pieces from a range of Japanese brands, add to Sato Seni's market strength. It is a clever way for controlling the image and narrative of the company.

Logistics

Logistics is a central part of any textile manufacturing operation. At Sato Seni there is a team of 50+ people performing bookkeeping, shipping, sales and market analysis tasks. Though Sato Seni is large by Japanese standards, it is only a modest producer compared to the rest of the world. It demonstrates that a textile manufacturer of even medium size requires long-term investment and inter-generational teamwork to thrive. A vision for the future is crucial to every aspect of the present operation of a textile company.

Recommendations and Considerations

The Fellow has a number of recommendations to make arising from their Fellowship experiences working at Sato Seni and seeing more of the textile industry in Japan. These recommendations might be implemented in the Australian sector around the role and place of a young generation of industry professionals in particular.

1. Improving collaboration and communication in the industry. Collaboration and communication with young industry professionals is central to the success of the industry. Viewed globally, the textile industry in Japan is not large. Yet Japanese manufacturers are always exchanging employees, knowledge, and resources. For the Australian industry to thrive, a network of young craftspeople should be developed and similar practices developed. There is a need for more open collaboration between companies and greater sharing of resources on this issue. **The Fellow will seek to act as a mediator between the younger and older generations of craftspeople. They recommends local manufacturers start conversations around their use of social media to promote collaboration and learning among young industry professionals. The establishment of a network of young industry professionals would promote the focused discussion of textiles, factories and future plans in a likeminded and inclusive way.**

2. Implementation of effective workplace practices in respect of young industry professionals. After their Japanese experience the Fellow seeks to offer their insight to Australian knitwear companies in order for them to develop similar workplace practices. From their time spent in Japan they observed that key success factor was organised and structured workplace planning, together with priority on the training of young people. The fellow recommends that businesses implement proper training schemes and support systems in places for both mentors and trainees. **The Fellow if required can offer his insights from his experiences in Japan as a young freelance knitwear technician to a range of Australian workplaces and help them develop new training practices and organisational models for young people and businesses.**

3. Passion for the profession among young industry professionals and the Textile industries image. Of all the cultural factors that the Fellow identified as crucial to the flourishing of the industry, the most important was a passion for textile manufacturing itself. The garment manufacturing industry all over the world is a tough one. Yet the future depends on the activities of new communities of practice. Moreover, the Fellow has identified that young people will only develop interest in this area if they are presented it in an appealing way through social media. An online presence is crucial to many emerging industries and textiles is no exception. **The Fellow will transmit his Japan experiences to younger industry professionals through in-person lectures, workshops and social media. The Fellow seeks to repackage the image of the Australian textiles industry through Instagram, in**

a way that is more appetising to young people. Generating interest with young people within the Fellow's sector will be a key part in sustaining the industry.

4. The government must improve apprenticeship schemes and offer better incentives to employers to train young people. As part of a long-term vision for reinvigorating manufacturing in Australia, investment in the education sector is vital. TAFE and university courses should include more manufacturing skills while program grants should be offered to encourage learning about textile and garment production. Given the Fellows personal experience in the TAFE system they are keen to share their insights and ideas around the issue. **The Fellow will seek to contribute to public debate about the inclusion of manufacturing skills-based education through community and government bodies like the ISSI. Furthermore, they will encourage their peers to contact their local Member of parliament and discuss training options and the future of textile manufacturing in Australia.**

5. Universities should improve their educational programs around knitwear and textile manufacturing. As the Australian textile industry Industry gets smaller and smaller universities have appeared to have failed to prioritise their textiles programs. Further they struggle to attain staff members with the appropriate experience to teach textile specific classes. **The Fellow recommends to approach universities to discuss their place in the regrowth of the Australian textile industry.**

Conclusion

The Fellow aims to continue their learning journey around knitwear manufacturing skills and techniques. His goal is to design his own unique textiles and garments. With a new understanding of knitwear production from his Fellowship experiences in Japan, he aims to create designs that will highlight a unique Australian sensibility. Beyond this, the Fellow seeks to communicate the joy and passion of knitwear manufacturing itself. The Fellow is committed to the renewal of the manufacturing community, and the importance of disseminating knowledge and skills in realising this future-oriented vision.

Appendices

This Appendix is the long format version of fellowship learnings section of the report, the Fellow outlines the technical details of his findings. There are a number of things that can be hard to grasp when considering the knitwear production chain. Yet it is vital to understand them in order to implement closed cycle systems. Here, the full extent of the Fellow's technical findings is documented.

The Fellow intended for the appendix to be drawn on by readers to gain extra knowledge around their area of interest. In this Appendix the reader expands on their knowledge of larger areas of interest such as spinning or gilling.

Head office 本社

Sato Seni's main office and factory

The heart of Sato Seni is its head office, where the company president works, and the first knitting mill is based. Sato Seni is unique in that its company brand symbolises both individual designs and an artisanal factory. This is Masaki's dual creative vison. Masaki's ideas drive the company today and many aspects of Sato Seni are directly overseen by him on a daily basis. Head office contains the sales, design and planning, knitting, pattern making, sampling, cutting, linking, sewing, steam set, check, and packaging departments. It has a small dispatch team and a large lunchroom.

Figure 33. The front of head office

Knitting mill 2.0　第二工場

Sato Seni's whole garment factory

The second knitting factory specialises in WHOLE GARMENT TM manufacturing. This factory specialises in fine gauge technical knitting that is zero waste and seamless. It is different from the first factory for a number of reasons. First, as Shima Seiki WHOLE GARMENT TM knitting machines are state of the art and a valuable asset of Sato Seni, the factory has a corresponding level of security and secrecy around it. Second, although the factory has 150 machines it only has 14 technicians operating the entire facility. These technicians are highly trained and have close connection with the Shima Seiki company. The standards of this small team are of the highest kind, and their goals are qualitatively different from the knitting team at head office.

Yamagata Finishing and Dyeing 山形整染

Sato Seni's dyeing factory

Yamagata finishing and dyeing is a large dyeing and washing factory located in the foothills of Sagae. Unlike the other factories it was not created by Sato Seni but was acquired from an old managing company. Previous to Sato Seni the factory faced numerous issues after Sato Seni's restructure, the company has blossomed into a smoothly running and profitable business.

Figure　34. Tesshun at the dyeing factory

Mizumi Factory 三泉工場

Sato Seni's artisanal yarn spinning factory

Mizumi Factory is one of two wool processing and yarn spinning Factories. It produces intricate and artisanal yarns on a small to medium scale. It has a wider range of departments for dealing with different wools. It is located next to the Sagae River and surrounded by cherry tree farms.

Figure 35. The long Mizumi factory and some patches of farm beside it

Top Making Factory

Sato Seni's offshore top making factory

Sato Seni, like almost all yarn spinning factories outside of China, does not produce its own top. It purchases its top from a factory in China that scours, cards and combs raw wool from around the world. However, outlining the process is key to understanding the complete knitwear production chain.

Figure 36. Sato Seni's carding machine used for refinement

Scouring and carbonizing (offshore)

Scouring is the process of washing dirty wool after it has been shorn from the animal. Wool contains a large amount of grease, dirt and vegetable matter that needs to be removed before it can be further purified through the carding and combing process. Scouring was once just a thorough washing but in modern times it uses chemicals to efficiently eliminate all impurities trapped in the wool

As it is done off-shore in China, the scouring process uses acids and chemicals. Japan, like most other countries, buys its pre-scoured wool from China. Sato Seni investigated establishing their own scouring plant but discovered it only became profitable on a very large scale. In China, the process also produces unwanted chemical run-off. Sato Seni, believe it would be beneficial to complete more scouring in Australia, where its environmental impacts can be much better controlled and effectively eliminated.

Carding and combing (offshore)

After the wool has been scoured it is clean, yet still in a relatively raw form of fluffy woollen clumps. These are carded so that short fibres are separated and extracted from the desired longer ones. The industrial carding process makes use of a system of vertically stacked tubular brushes. These

brushes are essentially like hairbrushes untangling the wool and getting rid of contaminates. The carding process extrudes brushed wool into a sliver around four to six centimetres in diameter. This is wound up on itself like a giant ball of wool to be transported to the combing machine.

The woollen slivers are convergently fed into the combing machine. The combing machine uses a large set of metal teeth to align the fibres. It spreads the wool fibres, puts them through a comb then runs them through a fine-toothed brush that systematically lays the brushed pieces together. Then these are extruded and balled up again for transportation.

It is important to note that Sato Seni also had a combing machine that they use to recomb fibres they have purchased. This is essential when producing worsted yarns, as wools that have not been combed remain woollen yarns.

1.1 Mizumi Factory: Pre-Spinning

Pre-spinning process or gilling

Gilling is the process of taking a rough ball of wool called a head and combing it until it can be extruded into a fine sliver before it is spun. The combing, rolling and pulling that is needed to gill wool is done by a number of different machines. It can sometimes be hard to discern the specific purposes of these different machines. Therefore, a brief explanation is useful. A gilling machine is any machine used after carding or combing that purifies the wool. They are all machines with an entry port that the wool sliver is fed into. The wool passes through a roller and comb and an extruder spirals out the wool into a can.

They are all machines that have an entry port that the sliver is fed into. A roller and comb that the wool passes through. And an extruder that the woollen sliver comes out into a large barrel called a can.

The first machine the *Mixer* blends the large heads of wool together. The *Leveller* evens the yarn out quickly making it flat and a uniform. The *High-Speed* gilling machines further refines the woollen sliver. Very fine yarn can be achieved through repetitive high-speed gilling which extracts impurities and aligns the fibres further. The *Bi-coiler* then prepares the yarn to be uncoiled from and wound onto a cone. The *Rubber* if used, is implemented to give strength the sliver. Then the Finisher winds the coiled-up sliver onto a cone.

A few methods and measurement systems are used to further control the wools fineness in the gilling stage. One is an established measurement system of U% which is maximum standard deviation. Or the overall evenness of the wool. A specialised machine is used to test the wool for its U%. This machine also records its weight per metre.

The next method of wool control is called draft. Draft ratio is the term used to identify the difference in speed in the back and front roller. This is the pulling force that the gilling machine uses.

Then is doubling which is the number of slivers fed into a machine to be extruded into one end. This doubling process is extremely important to achieve a uniform and even wool with little variation in shape. Although we cannot see it with our eyes, premium yarn comes from even yarn that's fibres have been aligned neatly.

These methods and measurement systems is where the human skills are applied. On the factory floor the process is fare from simple as well as physically demanding. Due to the fact of cleaning machines, transporting cans to the various gilling machines and constantly monitoring sliver quality.

Figure 37. View of inside Mizumi factory from overhead

Mixing

The mixer splices different heads of wool together, allowing the blending of different fibres or colours (for example, an alpaca and wool blend or an Acrylic and mohair blend). It utilises special rollers to first unwind the heads of wool that have come from combing. It then sprays a small amount of oil on half of the wool as it splices the heads together, re-hydrating them before the rest of the gilling and spinning process. The liquid spray is important in reducing static electricity and aiding the spinning process. After the wool is sprayed and spliced, it is sent through a set of combs and extruded into a can.

Figure 38. Mixing machine from the back and front. Intake rollers and splicing trays

Leveling

The leveller allows precise control of the wool's thickness and density. It contains a set of rollers and combs, but it also utilises an extremely powerful set of rollers that not only controls the draft precisely but contains a measuring device to detect the wool's texture and density down to the micron. It also has a knot spreader.

Figure 39. Leveller side profile, intake rollers and knot spreader

High speed gilling

The highspeed giller is essentially a thorough and ultra-fast combing machine that serves to further align the woollen fibres. It is integral to achieving high-quality yarns. Using the technique of doubling, many cans of yarn are converted into a very fine quality of fibre.

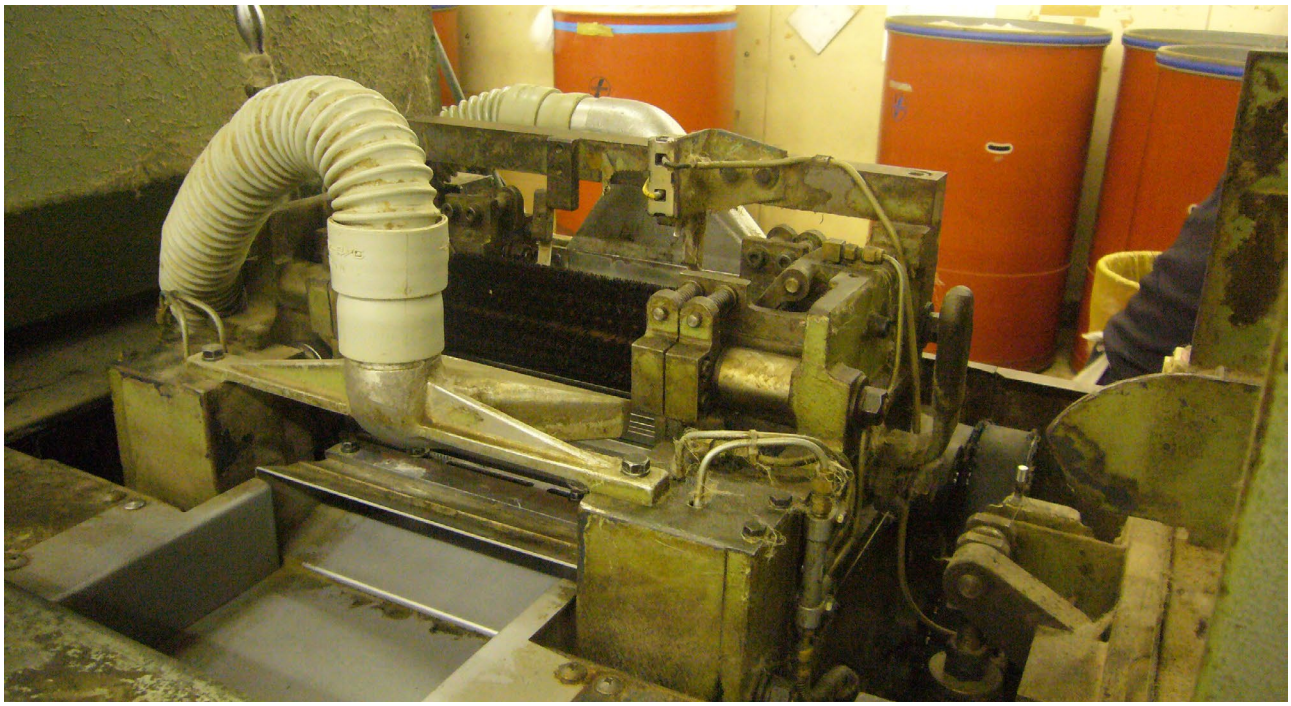

Figure 40. Combing box that contains rows of combing needles of the High-speed Giller

Bi-coiler

The bi-coiler rolls and combs the sliver and also coils the yarn into two different slivers in one can, the two coils winding in opposite directions. This means they can be uncoiled easily and wound onto a cone. This machine extrudes into two cans simultaneously i.e., it extrudes four ends of sliver.

Figure 41. The twin cans of the Bi-coiler

Rubber

The rubber is generally only used in the processing of tricky to spin yarns. It takes in bi-coiled yarns and rubs them between a set of aprons to slightly strengthen and extrude the yarn. It is an extra step to lower breakages during the finishing and spinning process ahead.

Figure 42. The numerous cans being fed into the rubber and its quad output

Finisher

The finisher is the first time the fibre is wound onto a cone. It takes the two ends from a bi-coiled can and feeds them into a small set of twin rubbing mats (aprons) that add a final amount of twist and density before being fed through a twin winder that lays the two ends side by side on the same cone. It is important to keep in mind that the other machines refine the fibre but do not strengthen the sliver. The rubber and the finisher add the body the sliver needs before being wound onto a cone.

Figure 43. The finisher winding on

U% measurer

The U% measurer is a measuring device utilised after every stage of the gilling process. It is a machine in which a woollen sliver is fed through two metal rods to measure the density and evenness of the wool. Every time a minute difference is detected in the woollen sliver a meter ticks higher. The higher the meter reading, the more uneven the woollen sliver. This machine helps craftsmen slowly track the refinement of woollen slivers.

Figure 44. Measuring devices of old and new

Mizumi Factory: Spinning

Spinning

Spinning is the process of turning a sliver of wool into a yarn. The slivers that have previously been refined in the gilling process are now turned into yarn using special machines. These machines all harness the same basic dynamics of twisting and pulling of hand yarn spinning. There are a range of machines that create different yarn. Sato Seni mainly use two different types: ring spin which is used for making standard knitting and weaving yarns; and trispin which is used to make artisanal and creative yarns for diverse design applications.

Figure 45. The many heads of spindles and heads of wool on a ring spin machine

1.2 Ring spin

Ring spin is one of most common types of industrial yarn production techniques. It is a type of bobbin spinning that derives its name from the two rings that are around every spindle on the machine. Any ring spinning machine has four essential elements. Firstly, a cradle that is a metal frame that bobbins of woollen sliver can hang from in mass. Secondly, a spinning bobbin that sits at the bottom of the machine. This is what the yarn is spun onto. Thirdly, small rollers and aprons that take the sliver from the cradle and extrude it on top of the bobbin as it spins. Fourthly, it is sent through a set of rings that surround the spinning bobbin that twist the sliver at high speeds to form a yarn.

These rollers, aprons and rings are essentially the hands that spin the yarn. They feed out and grab the woollen sliver and then the circular winding force of the bobbin is converted into a twisting and pulling force that gives the yarn its finished and strengthened quality's.

Throughout this process there are countless steps that a technician must undertake and monitor in order for the machine to run properly. For example, loading the sliver bobbins at the top of the machine, loading the yarn bobbins at the bottom. Manually winding on a small amount of yarn from a previous cone in order to be able to start winding the full bobbin. Then, monitoring spinning and fixing breakages as they occur. These machines can run very fast but that often leads to a high number of breakages in natural fibres. Therefore, technicians have to be constantly walking up and down a machine fixing yarns when they break.

Different fibres have different properties and abilities. Mohair fibres are significantly longer than woollen yarns but are very slippery and can be difficult to spin. Therefore, technicians must take extra care and use slower machines.

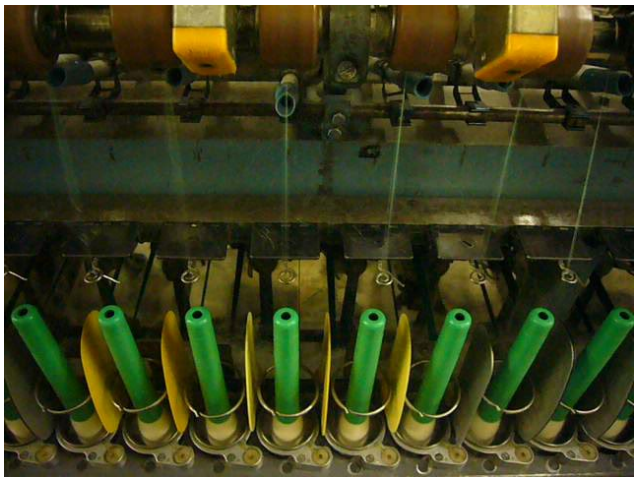

Figure 46. Close up of the woollen yarn being twisted and the bobbin sitting on the spindle

Ring spin: knitted yarns

The ring spin process can be used to create either weaving or knitting yarns. However, with knitting yarns a number of factors need to be changed. Knitting yarns are thicker and less dense than weaving yarns. They are much larger in comparison. Therefore, the machines used to make knitting yarns are bigger. They are exactly like a ring spin machine but on a larger scale. The sliver that is fed through the machine is also larger.

Figure 47. The chunkier knitting yarn ring spin machines

1.3 Trispin (loop yarn)

Tri-spin (sometimes called yarn twisting or “fancy yarn making”) is an Italian invention that twist three, single-ply yarns into one. It is also one of the most difficult spinning machines to maintain and use as it has three times the number of moving parts of a normal spinning machine. The Sato Seni staff who work on these machines are all highly trained, with slightly different specialities. According to the fellows account, even after a year of working on them every day, one still cannot understand everything the machines do. The staff person in charge had been working the machine for ten years and said every day presents new challenges.

Trispin is unique because it can combine and produce many different textures. It combines three single ply yarns into one. The first being the core yarn that sits in the middle. It is a stable yarn that has been pre spun and its bobbin hangs high on the machine, the second yarn is the wrapping yarn, this is the yarn that winds around the core yarn. This yarn can be unstable on its own. Then in order to stop the wrapping yarn from sliding up and down the core yarn and third anchoring yarn is introduced. This means that trispin can wrap a fluffy yarn around and thin one. This allows for a huge number of yarns to be created. The machine uses pre-spun core and anchoring yarn but spins the fluffy yarn that sits between it. It also has computers that can change the spin or twist rate of the yarns, allowing for infinite variation.

Figure 48. Various tri-spin yarns

No supplementary photos around Tri-spin were included due to the secrecy of the machines and techniques used at Sato Seni.

1.4 Cone winding

Cone winding is a vital transitional process for making yarn. It can be easy to overlook. It involves getting the smaller plastic bobbins on which the yarn is initially wound and re-winding it onto a cardboard cone appropriate for selling or twisting. The machines that rewind the smaller bobbins onto a cone are entirely automated but must be manually operated to fix errors or when a new larger cone to wind onto is being introduced. The small plastic bobbins used by a larger spinning machine are wound individually onto a cardboard cone by this machine. A cone for knitting might contain around 10-20 smaller bobbins.

The operator hand winds on a small amount of yarn from the bobbin to the cone and then places the cone on the machine. The machine then re-winds the rest of the bobbin. Once it has reached the end of a bobbin it automatically splices the new bobbin end to the cone end. Yet due to tri-spin being capable of producing such a fine yarn, trispin yarn can only be hand knotted in the cone winding process. Therefore a operator must re-tie every bobbin yarn to the cone yarn being wound.

Figure 49. The winding machines

Steam set

High twist yarns such as mohair, created on a ring spin machine, are steamed to lock in their twist. A Z-twist yarn that has been spun anti-clockwise needs to be stabilised before twisting it into a two-ply yarn. Some yarns that are very fluffy need to be shrunk before there are knitted. The wound bobbins that come from the spinning machines are loaded into a large crate and sent into a pressurised steaming chamber where they are steamed to achieve the shrinkage or the consistent twist desired. If a yarn is not properly steamed it can cause a garment to twist after knitting or shrink too much during the steam set process.

Figure 50. The steaming chamber that large crates of bobbins are put into after spinning

Twisting

Sato Seni's twisting facility is outsourced to a small-scale company. At the time of writing this report, Sato Seni is their only contractor. The twisting factory is about the size of a large domestic home, and only contains twisting machines. The yarn twisting process takes two pre-spun single-ply yarns each with either a Z or S twist and twists them together. This cancels out the yarn twists and makes them into a stable two-ply yarn. This ensures the yarn does not twist after the garment has been knitted or woven. It also ensures the desired thickness of yarn is achieved. Similar to the ring spin machines, first two single-ply yarns are wound onto a two-ply bobbin. This untwisted two-ply yarn is then fed through a twisting machine that uses a set of spinning hooks to twist the yarn and feed it onto a cone. The yarn has now been twisted. Sometimes it is then steamed again to lock in its twist.

Figure 51. The twisting machines

1.5 Dyeing

The dyeing process contains two parts, the testing phase and then the dyeing phase. Dye testing is extremely important in order to achieve consistent dyeing results. Different fibres call for different dye's chemicals and treatments. A blended fibre may need to be dyed twice with two different chemicals in order to achieve one colour, or the second dye may need to be chosen in order to not affect the previous dye colour. This testing room is a laboratory that contains chemicals, scientific testing tools and recipes developed by dyeing craftspeople. From this, two different types of dyeing occur, cheese or hank dyeing.

Figure 52. Left, cheese dyeing. Right, hank dyeing

(1.5) Hank Dyeing

Hank dyeing is a very reliable and consistent way to dye yarn. In principle is an ancient technique. It involves winding the yarn into big loops called hanks, these are big lassos of yarn. Theses hanks are then hung one by one in a dye-vat on rails. It is very gentle in comparison to other industrial dyeing techniques. Yet it takes a lot longer, due to the hank winding and hank-hanging process. For this reason, it is considered a craftsmen technique and is a mark of good quality. It consistently produces softer feeling vibrant yarns.

(1.5) Cheese Dyeing (Package dyeing)

Cheese dyeing or package dyeing as it is sometimes called, is a way of dyeing a large amount of yarn. Cheese dyeing involves winding yarn onto a set of cones that are then stacked onto vertically poles within a vat. The vat is then sealed, and it placed under pressure and flooded with dye. Cheese dyeing allows many heads of yarn to be dyed at once, very quickly. It also allows the use of pressure in order dye synthetic fibres. Due to the fact that synthetic fibres can be imperviable to most dyes, pressure is used to force the dye particles to bind to the yarn. Although this process is quick it can create waste due to the outer yarn of the cheese blocks becoming over saturated and often having to be discarded.

Hanking

Hanking is the process of winding yarn into a large circular loop. It has no cone and is a bundled-up circular pile of yarn. Hanks are ideal for dyeing as they can be hung from rails in a special hank dyeing machine. Hanking uses specialised machines to wind the yarn off the previous cardboard cone and onto a spinning wire frame that the hank can eventually be removed from. Hanking is another easily-overlooked yet integral part of the yarn making process like twisting. These types of specialised jobs are often undertaken by contractors. Sato Seni is investigating producing its own hanking division through the buying out of an existing hanking factory.

Figure 53. A closer look at the hanks, hanging on rails in the dye vat.

Yarn Storage

A place to store and classify the yarn produced before it is used or sold is crucial. Sato Seni has a yarn bank for its technicians to use for production and sampling. This contains a wide variety of yarns that can be drawn on to create new garments and knitted textures. It is a large four-story warehouse to pack and store yarn before sale across the world. The careful storage of yarn ensures it can be readily accessed and shipped in a timely and orderly fashion.

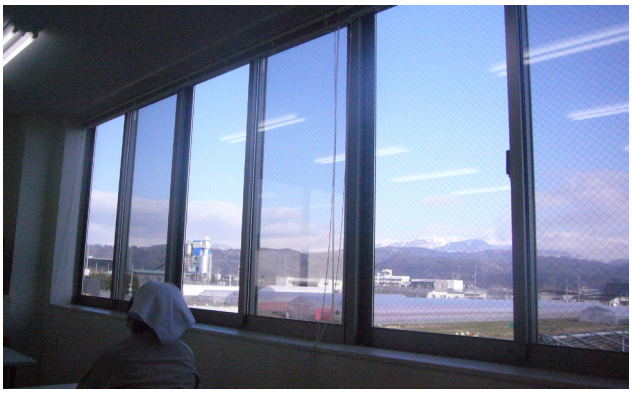

Figure 54. The lunch room at Mizumi Factory

Head office: ground floor

1.6 Design and planning

Sato Seni's design department, like many design studios in Japan, leans towards planning with the application of design thinking. It is consumer driven. The design team work closely with the sales team. Data on sold garments and popular models are regularly given to the design department. All designs have to be approved by creative director Masaki Sato. Another truly unique aspect of the design team is that some staff actually started as knitwear technicians or sales analysts so many of them are able to make market-informed judgments. Some designers work directly on their own samples. The communication across departments leads to thoughtful design creations.

Technical process

- Usually planning for a collection starts around a year in advance.
- The first step is mapping past sales, talking with the company director about the collection, its brief and designing mood boards.
- Next is textile design sampling. The design team assembles a library of swatches. Due to the fact that Sato Seni uses wovens as well as knits in their garments, a range of textile swatches are ordered from a vast rage of weavers and textile mills across Japan. Then a number of knit swatches are made in collaboration with the knit department.
- From these samples designs and accompanying techpacks are made. Each season (SS or AW) anywhere from 80 to 100 designs are produced. During the winter its normally around 100 and during the summer its normally towards 80.
- Meetings between the designers and the knitwear technicians take place in which knitwear technicians can choose their project. Although often a technician will have their speciality which a designer will seek. For example, a certain designer might want to make a certain intarsia design, from this they will see a special technician that has a lot of skill around making intarsia.
- The designs are then sampled and modified.
- Post sample. The tech packs are re-viewed. And final designs are decided in line with the company Directors choices.

(1.7) Sales 営業

Sales is a broad term used for an extremely large department of Sato Seni in charge of all ingoing, outgoing and internal orders, made by both customers and employees. There are a few sub sections of the department that address different aspects of sales and ordering. Sales is key to Sato Seni's operation, and a driving force of the company. The sales team are not just located in Yamagata but in Osaka and Tokyo because of Sato Seni's popularity across Japan

(1.7) Internal Orders

Although somewhat overlooked Internal orders are extremely important. A company like Sato Seni, on top of its specialty machines and craftsmen, needs a vast number of tools and materials in order to run. For example, if the cutting team needs a new pair of scissors, they will order it through the internal orders representative. The tracking and ordering of small bits and pieces by an individual staff member is extremely efficient.

Also, there is another part of internal orders that is in charge of requesting manufacturing or ordering products that the company does not make. For example, at this moment in time Sato Seni uses a range of woven materials that have been produced by other local factories in their collection. Furthermore, they offer a wide range of yarns that are made all across Japan and not just at Sato Seni.

(1.7) Product Orders

Customer sales division is comprised of a very large team of people. With offices across three different prefectures of Japan. All addressing slightly different aspects of consumer demand. Sato Seni although a Designer label, is also a yarn supplier and manufacturer. Long before Masaki Sato was in charge it was purely a yarn manufacturer. After his innovation it became both a label and a manufacturer in a very unique way.

Due to this there are two primary sales departments. Spinning Division and Design Division

(1.7) Spinning Division

Spinning Division coordinates every transaction internally and externally that relates to yarn. This is not only sales but discussion of new projects with yarn craftsmen and also calculating the amount of yarn needed to produce a collection based on pre-sales. Due to yarn being a core element of the company they do a vast amount of coordination and ordering.

(1.7) Design Division

The Design Division is the team responsible for new labels and all of Sato Seni’s collections. They coordinate, manage numbers and track production for all clothing produced by Sato Seni. They also gather data around past sales to inform designers around well selling items.

Head office: production upstairs

1.8 Pattern making パタン

Pattern making is the starting point of any textile production process, although the role of the pattern maker at a knitwear company has some key differences in comparison with one that does not have such a specialisation. In Sato Seni there are three to four pattern makers: one or two trainees, a senior employee and the head of department

- The pattern making department at Sato Seni was entirely CAD based on computers. Within Sato Seni there are two types of pattern making at play. The patterns that are made from design illustrations by the pattern making department in the pattern making software. Secondly the patterns that are developed on the knitting machine software in order to make that same shaped pattern on the knitting machine.
- Due to the differences in knitwear and pattern making programs it is the duty of the knitwear technician to interpret the pattern shape into the knitwear program.
- Firstly, the pattern maker develops pattern on CAD. This pattern making software triangulates patterns exactly and allows rapid development and revision. The files that the program produces are compatible with a vast range of printing, cutting, and knitting machines.
- Using a special printer, they print the patterns full scale and deliver them to the knitting team.
- With the chosen design they have already sampled, the specialist technicians then translate these pattern pieces onto knitwear programming.
- A sample pattern piece is produced. After they are all knitted and assembled by the sampling team it is able to be graded using the knitwear programming. The Program can now be used in production.

Sampling

The sampling team is highly skilled. It is comprised of eight veteran employees with broad knowledge and experience. They produce between 80 to 100 garments in any two-month period. They employ different manufacturing techniques to produce a diverse range of products, as well as fit and modify them. They develop a product and provide instructions to the production team to manufacture it at a consistent quality.

1.9 Knit production

Sato Seni employees a fleet of approximately 250 Shima Seiki knitting machines that utilise a type of highly technical visual programming, called Knitwear Paint TM, to produce a wide range of knitwear. This program is part of a range of programs and machines developed by the Japanese company called Shima Seiki. Shima Seiki is one of the largest knitting machine companies in the

world and their head office resides in Wakayama, Japan. They not only manufacture the knitting machine but also produce knitwear, train customers, have teams of designer and programmers experimenting around knit and also have museum centred around the history and methodology of the company.

Sato Seni's knitwear production is the heart of the company. It manufactures many different kinds of garments using a variety of techniques. Though Sato Seni sometimes produces textiles for other companies, its label has a distinct market status due to the high importance it places on craft skills. There is a considerable range of old-school and state of the art knitwear programming and manufacturing techniques employed across two different factories.

Sato Seni batch manufacturing business model allows the skilled knitwear craftsperson to be a part of a garment's full creation cycle. Considerable communication between departments takes place during the making of a knitted garment. The knitwear technician is expected to produce the knitted pieces from start to finish. This allows the company to produce high quality artisanal knits that have been shaped by the knitwear technician's original vision for the garment

Two main types of garments are made at the main factory:

3. Cut and sew, this is to be knitted and cut out by the cutting team.

4. Fully fashioned, these are knitted panels intended to be linked together by the linking team.

Fully Fashioned: most often used to make classic knits, like sweaters.

- The knitwear technician is delegated a garment by their superior or mentor within the department. They are often given specs like colourways or yarn choice but sometimes it is up to their own judgment.
- The technician will begin to program a swatch using a visual code within a specialised program called Shima Seiki KNIT PAINT TM. The coding also requires a specialised computer and keyboard.
- After the sample pattern program has been written it is translated into a special code for the machine to read, it is transferred to the machine either on floppy disk or USB
- The sample pattern is given to the technician, and they program the sample pattern pieces. The pattern pieces are experimented around and re-knitted in order to produce the product required. This can often be the most labour-intensive part of the process taking weeks for a singular garment to be programmed and knitted to the sample's specifications.
- Adjusting and changing the machine setting at every stage of knitting in important. Right from

when a new swatch is sampled the machine needs be set up correctly, then a new knitted piece will inevitably have defects that need to be dealt with through fine tuning the machine. Later when sampling and then in producing the process of machine adjustment is done. Generally, knitwear technicians need to understand not only programming but also machine mechanics.

- The sample is ensembled by the linking team and sent for approval. Linking allows for flexibility in the seams.
- The knitwear program is changed or approved. They then rewrite the programs in order for it to be produced across a number of sizes and colours.
- The finalised knitwear programming file is given programmed onto the machine, and it is set to produce a large number of pieces. Often running overnight for a few days.
- Yet often they will encounter an error and stop. They need to be manually fixed before they can restart.
- The knitted pieces are then finished by taking of the waste yarn used to stabilise it in the knitting process. This is done by either the technician or their trainee.

Cut and Sew: most often used to make T-shirts and other highly patterned or graphic items.

- The knitwear technician is delegated a garment by their superior mentor within the department or the superior decides which product they wish to work on. They are often given specs like colourways, yarn choice or both.
- The technician will begin to program a swatch using a visual code within a specialised program called Shima Seiki KNIT PAINT TM. The coding also requires a specialised computer and keyboard.
- After the sample pattern program has been written it is translated into a special code for the machine to read, it is transferred to the machine either on floppy disk or USB
- The sample pattern is given to the technician, and they program the sample pattern pieces. The pattern pieces are experimented around and re-knitted in order to produce the product required. This can often be the most labour-intensive part of the process taking weeks for a singular garment to be programmed and knitted to the sample’s specifications.
- Adjusting and changing the machine setting at every stage of knitting in important. Right from when a new swatch is sampled the machine needs be set up correctly, then a new knitted piece will inevitably have defects that need to be dealt with through fine tuning the machine. Later when sampling and then in producing the process of machine adjustment is done. Generally, knitwear technicians need to understand not only programming but also machine mechanics.

- The sample is then given to the cutting team, and they cut out the pattern piece to be sewn by the sewing department.
- The knitwear program is changed or approved. They then rewrite the programs in order for it to be produced across a number of sizes and colours.
- The finalised knitwear programming file is given programmed onto the machine, and it is set to produce a large number of pieces. Often running overnight for a few days.
- Yet often they will encounter an error and stop. They need to be manually fixed before they can restart.
- The knitted pieces are then collected and sent to be pre-shrunk at the dyeing and washing factory. After they return to the main factory and their waste yarn in removed.

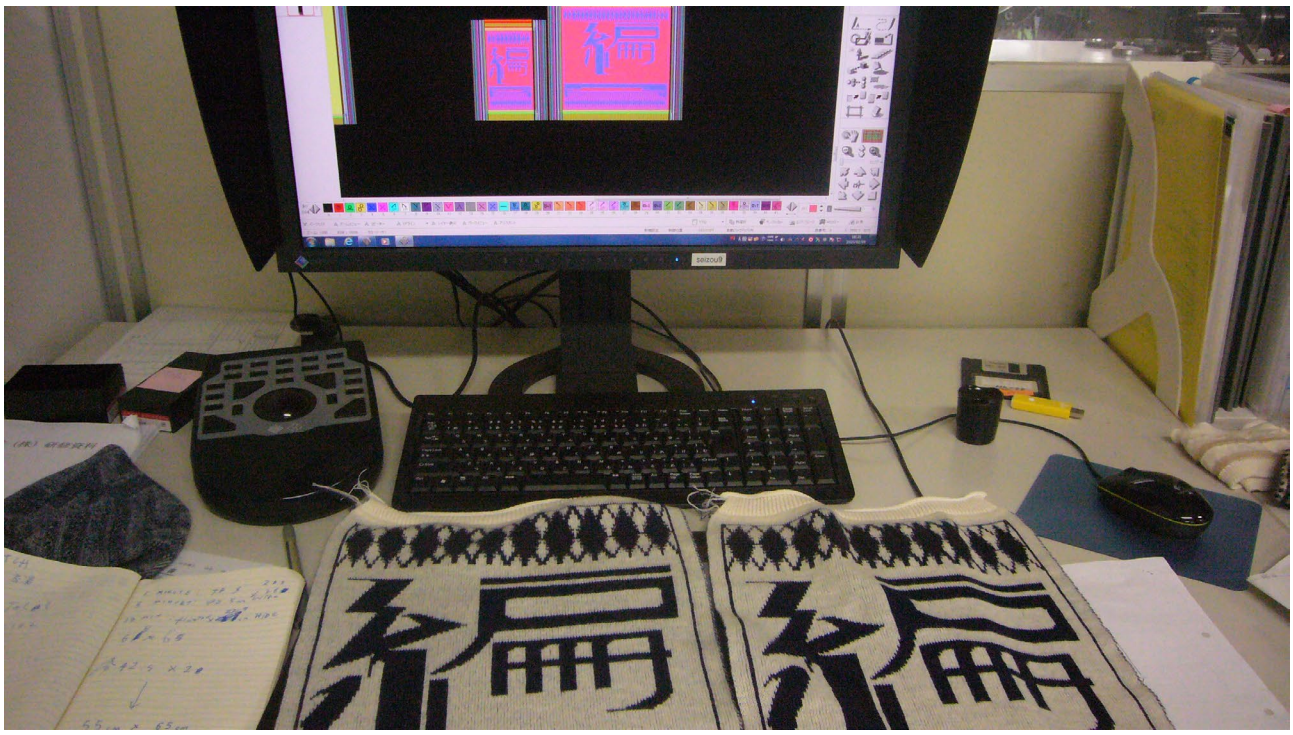

Figure 55. The Fellow using KNIT PAINT TM to develop a small jacquard swatch

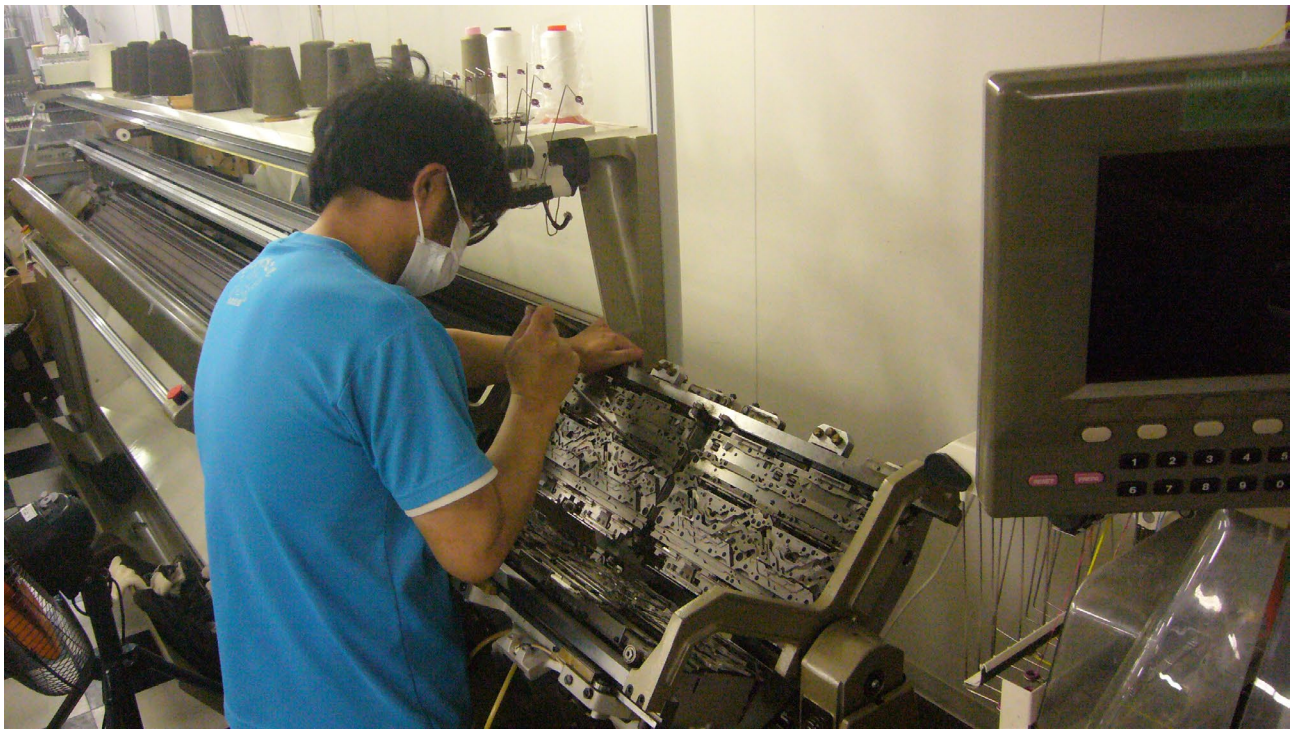

Figure 56. A knitting machine carriage hat has been turned upside down during repair

Figure 57. A look at the fleet of knitting machines at head office

Knitting mill 2.0

Wholegarment Manufacturing

Sato Seni produces WHOLEGARMENT TM knitwear for themselves and other companies. WHOLEGARMENT TM pieces are characterised as having no seams and being completely knitted on a single machine. These garments produce no waste. They are expensive to develop in small numbers but become cost effective to manufacture on a large scale. Due to this fact they are increasingly popular with established large scale fashion brands. As well as being cost effective and waste free, the varieties and application of WHOLEGARMENT TM knitwear are endless. The technology is used by NASA, medical companies, and haute couture fashion houses alike. Different silhouettes and 3-dimensional shapes can be created on the single machine using a single knitwear program. However, this means programming WHOLEGARMENT® knitwear can be labour intensive. Sampling often takes weeks and uses considerable materials and resources. Furthermore, the newer machines that utilise WHOLEGARMENT TM technology require years of training to be able to write their specific programming. WHOLEGARMENT TM knitwear technicians need to have highly specific skills to fix and maintain these machines. Often Shima Seiki is called on to help with these tasks.

WHOLEGARMENT TM process

- A detailed techpack is supplied to the wholegarment team
- They can either develop their own program or start from a base template program.
- WHOLEGARMENT TM knitwear programmers will often use a technique called “package” that allows them to write a small program that can be expanded by computer software into a bigger one. For example, they might draw in a small sweater program that is then expanded to a full size one. This is because a full-size sweater can take hundreds of small pixels to create. Then these pixels need to be perfectly placed within the KNIT PAINT TM drawing grid. Doing this through a software system that helps you scale up the program creates a lot less room for error.
- The program can now be exported and used for sampling, then reviewed and used for production

Yamagata Finishing and Dyeing

2.1 Washing

Washing is a tool to control aspects of the garment throughout the manufacturing process. It takes place at the dyeing factory which has facilities for both washing and drying. The act of washing and drying a knitted garment can be utilised to shrink it. It is an integral step to creating a stable garment that will retain its size and not stretch. This shrinkage can be harnessed in a number of ways as a design element. For example, the same scarf can have a completely different feel

depending on the wash and dry times used. Generally, a scarf will get denser and smaller as it is put through the washing process. If a garment is knitted with a thin yarn at a low gauge, it can be shrunk down to a higher gauge. A knit that has not been pre-shrunk can quickly stretch and then over-shrink in the drying process.

In order to achieve a consistent product washing and drying times are recorded very accurately. Firstly, the knit is washed with soap in large horizontal washers. This is done in batches, so all garments receive the same treatment. After they are drained and transported to extremely large dryers. Sometimes they are hung in a special room, to air dry on racks if they are a very delicate.

Figure 58. Industrial scale dyers

Garment Dyeing

Dyeing a whole garment at Sato Seni is not regularly done. Usually, yarns are dyed before they are spun, yet garment dyeing may be implemented to give a particular unique design feature to a garment or to rectify a mistake. When dyeing a finished garment, it can be difficult to achieve an even look. Yet some of the time an uneven garment dye finish is a mark of craftsmanship and may be used as a design feature

Head office: production downstairs

2.2 Linking

Linking is a type of specialised chain stitch applied by a linking machine that can sew knit seams together while still maintaining their stretch. It is a difficult skill that not only takes years to master but is very specific. At Sato Seni they value linking over wholegarment cutting and sewing, as the labour hours and craftsmanship that go into linked garments make them highly desirable. Linked seams stretch and bend, unlike a normal flat sewn seam.

The machines used for linking are tripod like drums which sew horizontally in a circle. The aim is to stretch the knitted seams over the teeth of the machine, and it will chainstitch through them. The way chain stitching differs from the plain stitching you find on normal sewing machines is the way in which a chain stitch is able to stretch.

Figure 59. A vast array of linkers

Cutting

The cutting team oversee all the cutting and sewing of garments at Sato Seni. This department works across a range of cutting tables, systematically lining up their design graphics and then cutting them out with scissors or electric rotary blades by hand. The reason for this approach to cutting is that complicated knit designs have slight variations due to stretching when being knitted. This means they cannot be layed up and cut with a programmed cutting machine as it would make a differential product. Therefore, they are stacked, aligned and cut out with precision by hand

The other side of the team was the computerised cutting machine. Headed by only two people. This very large machine cuts out woven materials. The machine used was called a Shima Seiki P-CAM it ran on the same programming used for pattern development which allowed lays to be drafted and then sent over to the machine to be cut. This automated machine was extremely precise and efficient.

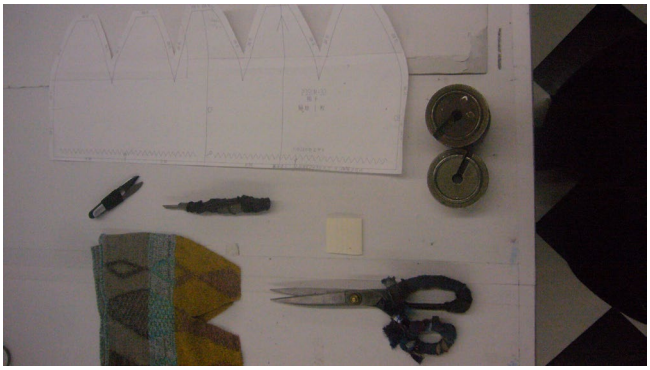

Figure 60. The cutting team at their tables, the cutting person's tools

Sewing

Sato Seni's sewing room is capacious and well-equipped. Its sewing team is the largest department in the whole company. Many staff are trained on the job, while some come from fashion colleges. They are talented machine sewers with the ability to produce a range of Sato Seni garments. Jobs are given to machinists in boxes, and contain all the documents and materials necessary for their construction. Each garment is assembled from start to finish by one technician.

Figure 61. The machine room

2.3 Steam Setting

Steam Set is a key aspect of knitting. It is often very undervalued from an outsider perspective. Steam gives garments their final finished form and allows them to stay that way. Knits stretch and are often crumpled when they first come off the machine so steaming is vital to producing a marketable product. The Sato Seni steam room is around 40 square metres with a humid environment. There are five steam beds, each with a corresponding table behind them. There is a boiler in a back room as well as washing machines and a dryer for sampling. Hanging on the walls are wire frames and rulers.

a. Garments are unpacked and placed on the table, numbers are checked, and the appropriate wire frame is chosen for the desired size. Flat wire frames are used to slide into garments before they are steamed. This shrinks or stretches them to their exact size required.

b. The garment is stretched over the frame and placed on the steam bed. Sometimes with garments that don't have a wire frame small tacks are placed into the table that mark things like a shoulder or cuff point. At this stage it is easy to stretch a shrink the garment to the right size with hand manipulation.

c. A foot pedal is activated to release a strong burst of steam that shrinks that garment.

d. Then another foot pedal activates a vacuum from underneath the steam bed that locks the steamed shape of the garment in by rapid cooling.

e. They the garment is packed and sent to packaging.

Figure 62. The steam beds and the wire steam set frames

Head office: product finalisation

2.4 Packaging & Product checking

Sato Seni considers every aspect of the company important. The staff who run the packing and product checking departments work with passion and diligence. Constantly considering new techniques and methods, the team is as craft-conscious as any other department. To produce and sell a successful garment, all aspects of it must be considered. Some members of these departments have been with the company for over thirty years. Packaging is the last process that happens at the factory. It is extremely fast paced.

(2.4) Product Check

a. Product checking usually took place right after the garment was sewn or linked together but before washing or steaming. Regardless of the garments shape it all had the same principle. Quality control is taken extremely seriously in Japan. There was no amount of imperfection that was tolerated. This led to the finest products. It also meant a lot using a very critical eye over products, for needing to pick up tiny details. The product check routine was also present at all stages of the garment's construction.

b. A large box containing the garments would be received as well as the garments manufacturing papers. The numbers would be checked and then the garments prepared in a pile to be examined.

c. Then one by one unfolded, inspected it front and back. Being given a slight stretch as being examined.

d. Then the garment would be taken to a cone lamp. A special lamp inserted into the garment to expose defects by stretching it and emitting light from within. They would move and sin in order to expose many angles of the garment such as collar or arm syce.

e. If defects where found, they would be sent to two craftspeople who worked in the knitting department who specialised in knit repairs. If not, they would be repacked into their box. There numbers recorded in a personal staff diary and sent to steam-set.

(2.4) Packaging

Packaging was the last process that happened at the factory. It was even more serious than the product check area. Further there always persisted an air of pressure and falling behind that made you want to work as fast as possible.

a. First the garment would be checked again. It usually would have some sort of crease from being pressed.

b. Then the garment gets its tags attached. The price tag and product details.

c. Then the garment is lint rolled. The lint roller makes sure the garment is clean (manufacturing process produces lots of dust). The lint roller is also used to move the garment into the optimal position for folding (Japanese lint rollers are very sticky and strong)

d. Then the garment is put into its plastic packaging and sealed. Loaded into a box labelled and then dispatched.

Figure 63. The Packaging & Product checking department and cone lamp

2.5 Knit Repairs and Inking

Garment control often leads to finding defects in garments and this leads to having to repair them. The company does not tolerate waste, so everything must be repaired. Despite the focus on skill and quality, defects are an inevitable part of the manufacturing production chain. When a flaw is found there Sato Seni have a team of people to fix the defects to the company's high standards.

Figure 64. Repairing tools; snips and a machine needle for tucking in stiches

(2.5) Inking (contracted)

Inking is the process of applying a small amount of fabric dye to a certain area of a knit to hide the dyeing discrepancies. Dyeing can be both minor defects of knitting or yarn dyeing. It sounds overly technical to be focusing on a shade of colour difference that can barely be noticed to the naked eye but when under contraction from multi-billion-dollar companies it is essential to delivering a consistent product. This process of inking is first marked by a product checker and then sent to an inking subcontractor.

(2.5) Knit Repairs

In the knit department, in the middle of the room surrounded by machines was a small table in which two ladies sat and did knit repairs all day. Often knitting machines no matter how amazing will occasionally drop a stitch in a piece. Sometimes it a 1 in 100 anomaly that was just perchance and sometimes it can be a pervasive programming issue that will impact a whole batch of items. When this happens it is the duty of these people to repair these dropped stitches to a point that is untraceable. They work very hard all day with a range of yarn and hooks to repair the tiniest gauge holes.

Select Retail Store

Another unique aspect of the Sato Seni franchise, and a contributor to its current success is the retail store located close to head office. This select store is named GEA, after the gears found in a gilling machines. A high-end shop, it stocks all of Sato Seni's brands, such as M&Kyoko, 991, Fugafuga as well as pieces that other brands had produced through Sato Seni. There are also innovative and popular brands like Maison Margiela and Comme des Garcons. The clothing for sale is curated by the shop manager. This collection of cool and interesting pieces from a range of Japanese brands, add to Sato Seni's market strength. It is a clever way for controlling the image and narrative of the company.

Logistics

Logistics is a central part of any textile manufacturing operation. At Sato Seni there is a team of 50+ people performing bookkeeping, shipping, sales and market analysis tasks. Though Sato Seni is large by Japanese standards, it is only a modest producer compared to the rest of the world. It demonstrates that a textile manufacturer of even medium size requires long-term investment and inter-generational teamwork to thrive. A vision for the future is crucial to every aspect of the present operation of a textile company.

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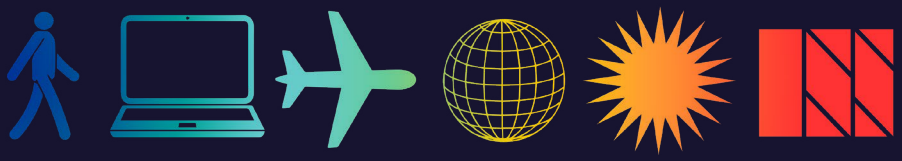

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