

Innovations in Jacquard Weaving at ITMA 2023

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Introduction

The 2023 ITMA exhibition was held in Milan, Italy June 8-14. ITMA advertised a focus on digital transformation and circularity in their promotional material and the show delivered on those ideas with an impressive display of advanced materials, innovative technologies, automation for a digital future, and sustainability. The weaving halls were abuzz with activity throughout the entire seven days of the showcase. Industry innovators gathered to display their new and updated state-of-the-art machinery. For twenty minutes every hour, the machines were powered up and passerby navigated through the maze of commotion to admire the various fabrics being expertly woven before their eyes. The diverse machinery wove a myriad of fabrics, some even showcasing the themes of the event, weaving words like “sustainability” or “ITMA Milan 2023,” while a special few tapestry looms wove near photorealistic images of the Duomo di Milano (as seen in Figure 1). In all, the impressive showings offered themes in innovation including automation, digitalization, and sustainability.

This paper will cover notable innovations in Jacquard weaving and will be organized alphabetically by company name. Jacquard weaving is characterized by its ability to produce large and intricate woven designs. On jacquard looms, harnesses are replaced by harness cords that are connected to heddle wires through which each warp yarn is threaded. Harness cords are connected to hooks at the top of the machine, and different machine types allow for different levels of control of warp yarns. For individual control of warp yarns, each hook is connected to a single harness cord that controls a warp yarn. Alternatively, each hook can be connected to a neck cord which controls several harness cords/warp yarns. The number of hooks corresponds to the size, capacity, or power of the Jacquard machine. Jacquard machines are further classified by their harness tie and types, which determine the fabric design that can be woven in terms of scale and orientation of repeat pattern (or lack thereof) (Seyam 2011). The discussion of Jacquard weaving machine innovation on display at ITMA 2023 will include solutions to design limitations, the expansion of the Jacquard machine’s overall size and power, and more.

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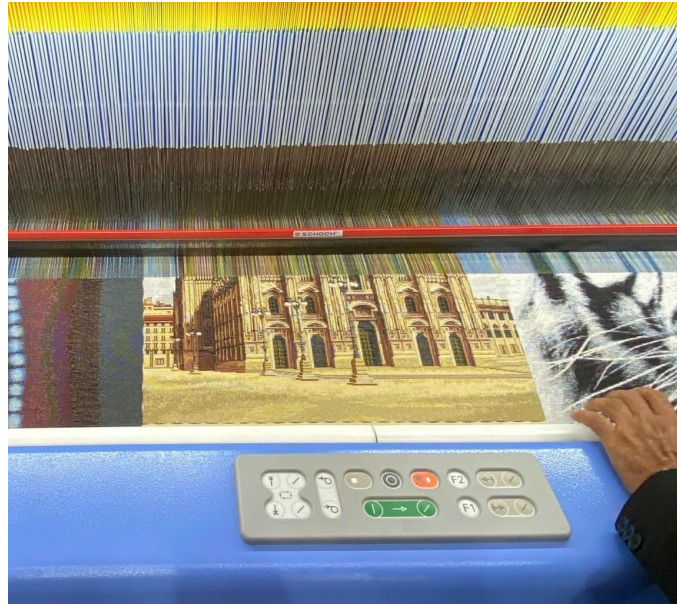


Figure 1. Vandewiele Jacquard loom demonstration

Stäubli

Stäubli exhibited several products in their booth within the weaving hall, including a number of Jacquard machines, offering a look at some of their impressive innovations in weaving. These included the LX PRO, LXL PRO, and LXXL PRO of their PRO series of Jacquard machines which were launched in 2022. Stäubli advertises these looms as ideal for consumers who seek top energy efficiency in the production of flat, terry, or OPW (one-piece woven) fabrics. The three Jacquard machines cover a range of formats, from 4,608 hooks on the LX PRO to 25,600 hooks on the LXXL PRO, and all have Stäubli's NOEMI electronics and MX PRO module. NOEMI is Stäubli's innovative intelligent electronic architecture that ensures precise and verified data transmission during weaving. The brand new MX PRO module featured on the machines provides reliable hook selection for all kinds of woven fabrics and boasts greater reliability and versatility as well as lower energy consumption. The Jacquard machines also employ new ventilation systems which moderate temperatures inside the module to extend the service life of the components and reduce energy consumption. The power supply has been optimized to be fully integrated within

the Jacquard machine, easing installation, lowering maintenance, and enhancing reliability. The Jacquard installation is equipped with a new generation Stäubli Jacquard TC8 Controller that is compatible with all Stäubli Jacquard machines and features intuitive operation, a user-friendly interface, expanded capacity, and increased data-transfer connections. The TC8 allows for the simultaneous communication of the color coding and hooking file to both the Jacquard machine and the weaving machine. The TC8 complies with Industry 4.0 to facilitate the work of operators, technicians, and management in weaving mills. The LX, LXL, and LXXL machines are differentiated by their formats (number of hooks) and their ideal applications. The LX PRO and LXL PRO are ideal for weaving flat fabrics, terry cloth, and technical fabrics on all types of air-jet, rapier and water jet machines. The LXXL PRO is ideal for weaving flat fabrics on rapier weaving machines in limited space.

Stäubli also introduced their new carpet weaving system, ALPHA. Their ALPHA 580 UNIVERSAL carpet weaving machine (as seen in Figure 2) presided over a huge portion of Stäubli's booth, allowing visitors to observe the face-to-face carpet weaving production in action as well as the

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rugs that were produced during the week as they collected at the base of four separate cloth rolls. Stäubli boasts the machine's easy yarn handling, compactness, and high level of reliability and productivity. The carpet weaving machine works on a double rapier system and combines a Jacquard shed formation of pile yarns with an electronic rotary dobby shed formation of the ground warp. The machine offers a wide range of carpet qualities and sizes (up to 5.3 meters in width). Up to 92 color combinations can be achieved on an 8 frame machine due to its

double and triple point technique. The machine offers high flexibility and can produce low, mid-range, and high-density pile carpets. The machine can control up to 33,792 pile threads by combining four LX 2494 Jacquard machines on the top. The ALPHA series also includes the ALPHA 560 UNIVERSAL, ALPHA 500 XHDC, ALPHA 500 SINGLELOOP, and the ALPHA 500 LEANTEC machines, each of which specialize in the production of different types of carpeting.

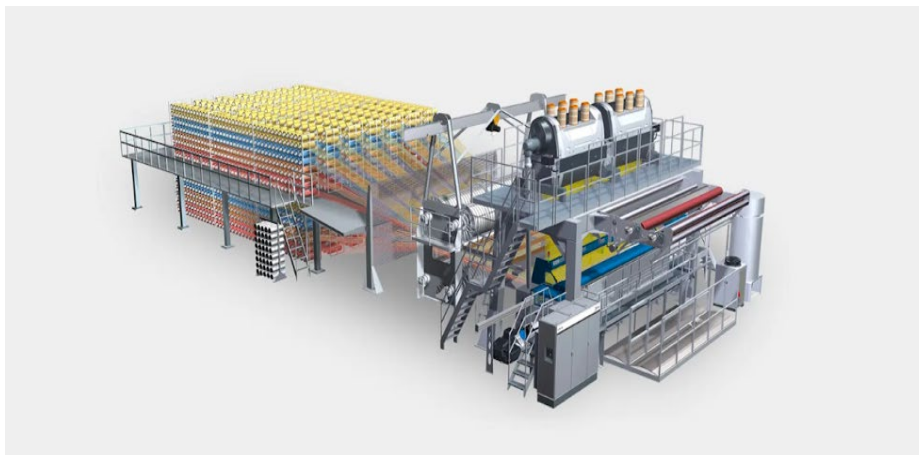


Figure 2. Stäubli's ALPHA 580 UNIVERSAL carpet weaving machine (Source: <https://www.staubli.com/us/en/textile/products/carpet-weaving/alpha-580-universal.html>, retrieved June 28, 2023)

Vandewiele

Vandewiele showcased their recent innovations in the development of carpet weaving machines, showing three new carpet weaving machines. The RCF carpet weaving machine with digital "Fast Creel" was on display as one of the three new carpet weaving machines. The RCF machine utilizes an electronic Jacquard head and a double rapier insertion system to weave face-to-face carpets for cut pile and flat weave applications in 3, 4 or 5 meter execution. This machine is distinguished by the ability to weave at its highest speed yet, up to 250 rpm. Also notable is its flexibility for quick color changes, lower machine standstill, plannable creel changes, and lower waste yarn. Vandewiele's new generation HCE3+ was

also showcased for its innovation in carpet weaving. It is equipped with Vandewiele U4 jacquard machines that allow for the application of highly productive three rapier weave structures and local flatweave effects for broader options in designing and writing text. Also notable is its ability to imitate hand-knotted carpets and create high pile density fabrics.

In addition to these, Vandewiele displayed their innovations in jacquard technology through their BONAS jacquard range, of which 7 were on display at this ITMA. Vandewiele's BONAS jacquard range covers the full spectrum of the weaving industry, with up to 31,104 hooks in a single jacquard or 62,208 hooks when coupled. Vandewiele advertised BONAS' ability to

weave high fashion fabrics through the combined use of their Ji Jacquard machines and their Smart Creel from which a variety of warp yarns can come, eliminating the use of a normal warp beam and allowing flexibility in yarn consumption. Vandewiele also developed the BONAS H3D Jacquard for 3-dimensional, multi-layer, and technical applications. Utilizing this technology, full 2 and 3 position up to 330 mm and full 4 position up to 430 mm sheds can be obtained with hook loads of up to 2 kg and hook capacities of up to 16,128 hooks. The BONAS range also featured innovations that centered around digitalization and sustainability. For example, their Si range is notable for its low energy consumption, featuring a Smart Drive that is equipped with a feed forward system that predicts the design-related load to minimize power consumption. Additionally, their Ce controller offers bi-directional data communication that includes features like Preventative Maintenance and Smart Energy Management. Bonas is also notably the only jacquard supplier that allows full diagnostics of the selection system.

Digital Weaving Norway

Digital Weaving Norway showed their Thread Controller 2 (TC2) loom, a unique technology that combines Jacquard weaving and the individual control of each warp yarn with the flexibility of handweaving. Put simply, the TC2 is a hand-operated electronic Jacquard loom. The TC2 accommodates endless weft materials and allows for instant changes in density and composition. Digital Weaving Norway underlined their technology's ability to meet the demands of a broad range of consumers—from designers, to architects, engineers, researchers, and artists—due to the loom's capability of rapidly prototyping weave constructions for the testing of performance and properties. The TC2 has a modular configuration, coming in three sizes that allow for simple configuring and reconfiguring to meet the consumer's needs. The TC2 contains automatic warp advancing technology made

possible by sensors and software-operated electro motors.

Digital Weaving Norway advertises the TC2 as a loom for creators. Popular among independent artists, the loom has been used to create customized or one-off pieces for haute couture, interiors, art installations, and more. The TC2 is an ideal tool for research and development teams at textile manufacturing companies, as they can utilize the loom for sampling and testing purposes without needing to pause production. The TC2 is also used as a tool for innovation with newly engineered materials like technical and smart textiles. For example, the TC2 is utilized in research wings of the defense forces, where it is used for prototyping new soldier uniform fabrics with built-in smart functionalities. The TC2 loom is also present in a high number of educational institutions throughout the world.

Conclusion

The new Jacquard technologies exhibited by the major companies in weaving machinery focused on innovation in reduction in power consumption, size, digitalization, automation, and sustainability. The presence of Smart technology like Stäubli's NOEMI intelligent electronic architecture demonstrates the interest in digitalization to eliminate error and offer data utilized for machine optimization. The focus on increased speeds across the various machines and technologies showcased emphasizes the importance of manufacturing efficiency, which correlates to profits as well as sustainability in factory operations. Interest in the ability of Jacquard machines to work in 3-dimensional, multi-layer, and technical applications is demonstrated by Vandewiele's new BONAS H3D Jacquard and could be further supported by the utilization of the TC2 for innovation with newly engineered materials. In all, the showings at this ITMA demonstrated impressive technological advancements that are sure to move the industry forward into an era marked by robotics, AI, and environmental regulations.

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