

The Effect of New Technological Development on the Modern Technology of Woven Carpet Industry

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Abstract: Modern technological development has become a key feature of the modern era, Where extended to include all areas of modern life, including the industry in general and the area of the carpet industry in particular. It has been observed in recent years, remarkable and rapid development in the industry, especially the face to face carpet industry, which is at the present time the top of the evolution of the carpet industry in the whole world, because of what achieved from many innovative products to suit modern life requirements and other products with special specifications are used in specific areas. From here this analytical study of the impact of some technological development factors on the evolution of the modern technology of face to face carpet industry, by applying this study to all stages of the carpets production from the beginning stage study needs of the market and the development of specifications even packing stage. The results showed that modern electronics technology are the most important reasons for the evolution of the carpet industry, followed by the use of computer applications. Also one of the most important results of the application of this evolution in the industry is creating new designs and modern specifications of carpet commensurate with high functional performance complies with the requirements of modern life in addition to this the application of quality standards in the carpet industry.

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1-Introduction:-

The world has seen in the last five decades, a tremendous development in the field of technology carpet, it also coincided with that too enormous technological revolution in other various industries, Which have a preferred pioneer in the provision of basic and supplementation and innovative needs led to update and improve carpet product to meet the different and multi- needs of humans. There is no doubt that the success of carpet technology at the moment depends on the progress of this technology and its ability to identify and meet the needs of customers and speed to design and manufacture of the product in order to achieve the requirements of the consumer with the appropriate cost, the evolution of carpet industry technology to achieve these requirements not be in the marketing and design only, but this development would cover all stages of the carpet industry and the product, considering that the carpet is a way out of this technology is delivered to the consumer. Carpet industry is one of the leading industries at the local, regional and global levels, and that the carpet product is a durable commodity, this is a competitive and important challenge for the possibility of Marketing. Here, the importance of the continued development of carpet industry technology in order to achieve the characteristics of the durable commodity which is durability and reliability so as to ensure that the product achieves its usability aesthetic and economic functions. Some of the studies were done before to study the evolution of the carpet

industry, such as the study that dealt with the developments in Axminster loom with the right type of loom development more 2-shot weaving, and Wilton loom⁽¹⁾. And another study which talked about the sociology of plastics in carpets as well as the technicalities, for this it dealt with the surface fibers such as nylon and acrylic and their extent of usability of the dye and the cost of this, and also dealt with carpet backings⁽²⁾.

From here was this study about the impact of the use of modern technology in the development of the carpet industry and increase the quality and quantity of the product to satisfy consumer, specifically the development in technology producing face to face carpets, so that in the present time this type of carpet is considered the largest and most productive and the most commonly used at the local and the global, and what has passed through many stages and successive.

2-Theoretical studies:-

Carpet industry is one of the industry overall for many other industries such as manufacturing of yarn and engineering industries and electrical, electronic and chemical industries.

As the carpet product passes the with a number of successive stages, we will address them as follows:

2-1-The concept of the process of product development:-

The effective development of the carpet product is not just a change in form only, but should include an added value for the user by improving the functionality of the product and its characteristics

measurable and evaluation in order to achieve satisfaction of consumers and satisfy their needs of the diverse and constantly changing, and in order to achieve a large economic return, to achieve all of this can put five determinants is essential to evaluate the performance of the process of product development:

1-The manufacturing cost of product: This cost includes all stages of design, production, finishing and packing, this cost determines how the pricing of the product in order to achieve the foundation appropriate economic return.

2-The product quality: This means the level of final product quality output of the development process, to achieve the requirements of the consumer, and the degree of trust and reliance on it, reflecting the ability of the product competitiveness and its ability to persuade consumers to pay the price versus the value added to it.

3-The ability to development: Means, the industrial organization's ability to develop product more effectively and efficiently.

4-Development cost: Where usually the cost of product development are part of the investment requirements to achieve profit.

5- Development time: Determines the time required for the development team to achieve its goals, as the time required for development determines the level of the institution response for competitiveness capabilities and technological development as well as to the level of speed receiver economic return of Development effort⁽³⁾.

2-2- Responsible for the product development process:-

Product development process is a complex process in which a group of integrated processes associated with each other to achieve an effective development, which appears an added value of the product that is reflected positively on the its competitiveness of the hand and the user directly and indirectly on the other, these processes can be identified as follows:

1-Marketing process

Is the process associated with the interaction between the industrial enterprise and consumers in order to determine their needs and desires, and provide products achieves satiate their desires and may even exceed their expectations.

2-Product design process:

It is responsible for defining and achieving and ensure the continuity of all the functions of the product usability and aesthetic, economic, avatar and environmental, etc., which is investigating the needs of consumers throughout the shelf life of the product.

3-Manufacturing Process:

Is responsible for all phases of production necessary to achieve the characteristics of the desired

product and achieve its functions effectively, and includes the supporting processes for manufacturing such as procurement processes for production requirements and supplements associated with the product, as well as the storage of raw materials and half made product and the final product through suitable storage environment and storage style ensures the preservation of what has been stored with required quality and available storage time. This is in addition to the transport and trading of the product or parts of it during the various and successive stages of industrialization⁽³⁾.

3-Experimental work :-

In this research, I focus on the impact of modern technological development on the technology of face to face carpet industry in recent years, through the study of the successive stages of the carpet industry, which can be identified as follows:

1-Study the needs of the market.

2-Design and preparation of specification for carpet

3-The provision of raw materials, and preparation of machines.

4-Carpet manufacture process.

5-The stage of screening process and finishing.

6-Stage of packaging and storage

In this research, a comparative analytical study was applied on the face to face carpet which produced on machines with Jacquard.

4-Results and Discussion:-

4-1-1- The effect of modern technological development on studying the needs of the market:-

In recent times the study of the needs of the market for carpets and floor covering has witnessed great development thanks to the development of information technology and the Internet, which has become available to everyone, resulting in:

1-Accessible to information has become much easier than ever before by searching the databases and websites, periodicals and electronic libraries and various research centres

2-Rapid access to information in limited minutes.

3-Obtaining accurate information and specific that have primary the role in determining the required carpets product exactly in terms of quantity and quality.

4-Many companies producing carpets and floor covering have become poses specifications of their products on the internet so as to help the client to identify their needs exactly.

5-Access to consumer opinion quickly and easily, (This, for example, be possible by the application of the electronic questionnaire), leading to new products and feedback that are useful for the continuation of some of the products and the end of others

6-Formation many new markets in many and different places at the local, regional and international.

4-1-2- Effect of modern technological development on design and preparation of specification for carpet:-

Carpet weaving has always provided the manufacturer with the outstanding advantage of being able to tempt the customer with the beauty of pattern as well as colour, and the design capabilities of carpet have progressively been extended.

By the application of modern technology to design carpets, The computer was used in the

implementation of carpet designs Which is called CAD (Computer Aided Design), which needs a lot of information and data in order to assist in the drawing and design.

Become a computer helps in many stages of the design until there is a clear integration between the of design in terms of shape and design specification, which must be applied to the design to turn it of the image into a three-dimensional Carpets product, Where Computer helps in many stages of design, which can be summarized as shown in Figure (1):

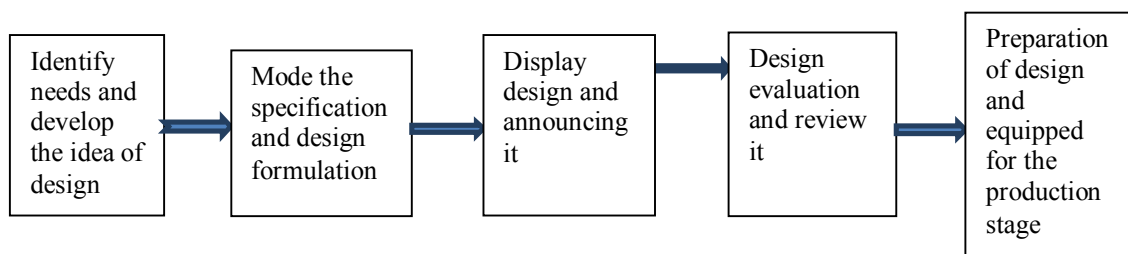


Figure (1): Stages of the design using a computer

What noted to near the end of the world of traditional design, where achieved the following advantages:-

First: the preparation of design, where the availability of the following:-

- Increase the ability to creativity and innovation through greater interaction between the designer and the amount of information available to him.

- The possibility of graphic and design modification.

- Merge more than one design together to produce new ideas and design solutions.

- Production of the design by multi-color ideas.

- Production design with multiple sizes.

- Completion of the design during the period of time is very limited.

Second: the processing of the design by the required specifications (conversion process). Where the required design specification will be equipped directly on the computer with the following requirements:-

- An area of design.

- Sort Order of colors on the creel of machine, which the design will be implemented on it

- Number of dents / cm of the reed used on the weaving machine

- Number of pile rows / cm.

- The type of Jacquard device

- The weave sets which include (Textile installation of pile - Textile installation of the carpet ground).

Where the design is converted from just image to the operating data for the carpet specification will be implemented, and thus the following features materialized:-

- High-speed in the preparation of design and bring it out in quick and diverse succession.

- Accommodating and put up an unlimited number of alternatives through the application of a large number of textile structures.

- The possibility of seeing the design in its final shape corresponding to the actual carpet (to simulate reality and interact with its and show carpet with real used materials).

- Error detection method uses a regulator mathematical logic that is not affected by sensory psychotropic.

- Accuracy of performance where the mistakes are rare.

- Require cost less and effort less.

- Send design directly into the operating path on the weaving machine.

Third: Simulated Carpet:

During the final stages of designing, the design on the screen has a grid-like appearance, rather like point paper. The image may be enhanced by means of an "electronic template" that simulates yarn shadows

and yarn hairiness, making it appear very much like a transparent photograph of the carpet surface⁽⁴⁾.

As a CAD system is not easily transported, it is common to bring potential customers to the design studio to view the image of the carpet on the screen, although the system may be installed at trade fairs to display collections of new designs. Certainly, it is useful within a carpet factory to view designs on the screen as a stimulus to discussions about them.

Fourth: Storage of Information and designs, Where the following achievements:

-Providing a tremendous amount of information and data for creating design.

-The possibility of using this information and data at any time and as quickly as possible.

-The diversity of information and data that is stored, which gives the opportunity to create a variety of designs.

-The possibility of establishing an indexed library for designs.

- The possibility of creating a file for each design from which to follow the stages of design innovation and its multiple sizes and colors possible.

4-1-3- Effect of modern technological development on the provision of raw materials, and preparation of machines:-

The evolution of textile materials technology industry has had a very significant role in the development of the carpet industry and floor covering, where it adopted on some basic factors are as illustrated in Figure (2).

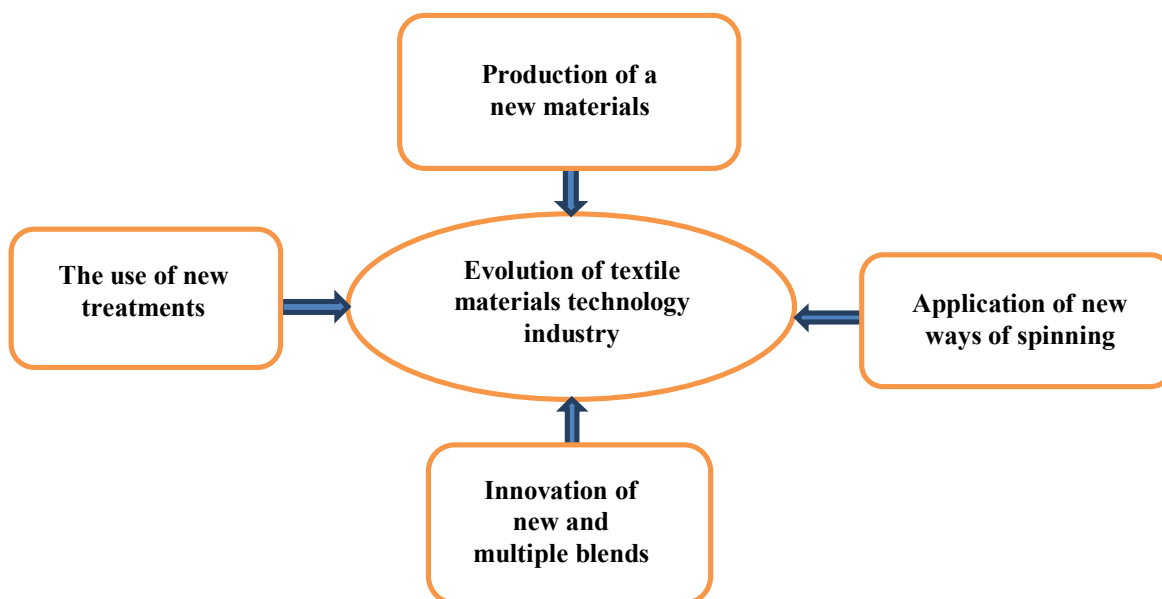


Figure (2): Factors affecting the Evolution of textile materials technology industry

This has resulted in many innovative advantages can be summarized as follows:

-In addition to the natural raw materials there has been producing multiple types of industrial yarns used in the pile surface texture of the carpet, such as nylon with its multiple types, polypropylene and acrylic. While the largest focus was on the use of the polyester as a major material in the texture of background of carpet. However, polypropylene is becoming widely used in both of the pile surface texture and texture of ground.

-Introduction of new types of fibers with specific functional properties by end-use such as conductive fibers. which are used in order to produce an effective antistatic carpet such as smart carpet. For this purpose,

these fibers are used in both of the pile surface texture and texture of ground. All these conductive fibers are dark in color, but the proportion used in the pile are so small that they are not distinguish, only through accurate research. Of these fibers there is stainless steel fiber that are blended with another materials to be conductive during carpet yarn spinning, such as Bekinox yarns are blended of 82% wool and 18% stainless steel fibers.

Also Nylon may be made conductive by incorporating a core, sheath, stripe or multiple stripes of carbon. Other fibers may be made conductive by treating them with Copper compounds such as acrylic⁽⁴⁾.

-Methods of spinning yarns become multi-, especially yarns used in the pile carpet industry and therefore many types of yarns produced such as continuous filament yarn, yarns made of staple fibers, bulk continuous filament (BCF yarns) and core yarns. Consequently yarn count used in the carpet industry varied to suit the production of carpets with multiple specifications.

-Pile Yarns gained a lot of advantages that qualify it for high functional performance when using the carpet, such as:

1-Crimp property that contribute pile yarn to be bulk, which is very important characteristics that make the pile yarns have a high coverage coefficient, which would lead to the availability of many of the characteristics that must be met in the pile surface of the carpet, such as (High thickness - high resistant to corrosion by effect of friction - High resilience - High noise absorption - High thermal insulation⁽⁵⁻⁷⁾).

2-Static electricity control by incorporating small proportion of conductive fiber in stage of spinning.

3-Flammable resistance: It is very important characteristics that must be met in the carpet, studies have proven that the material type of pile yarn has a very significant impact on this property, where nylon achieved the best results in flammable resistance⁽⁸⁾.

4-Fluorescence: It is aimed particularly at the market for carpet in the entertainment industry, where patterns visible under conditions of low illumination are sometimes required. An example of this specialty fiber is Du Pont's FootlightsTM version of nylon 6.6, which contains an additive that glows under UV light⁽⁴⁾.

5-Resistance to bacteria: An example of this fiber is Du Pont's LumenaTM solution - dyed nylon, which has inherent antibacterial properties that are durable to wet treatment. However, to create a carpet free from bacteria that can be responsible for allergies, infections and odours, it is necessary to address the entire carpet system⁽⁴⁾.

-Preparation of warp:-

First: pile warp yarns: The process of pile warp yarns preparation on the machine has evolved where these yarns are wound on large bobbins mounted on a big creel placed behind the machine, where allocated a frame for each pile color on this creel and thus achieved the following advantages:

-Bobbin size became so great to make it on the machine takes a long period of time so as to provide warping time and periods of breakdowns.

-High possibility to control the tensile reality on warp pile yarns, which increases the quality of the carpet product.

Second: ground warp yarns: These yarns prepared by direct beaming Which evolved using modern

beaming machines equipped with microprocessor that have achieved the following advantages:

-Control on winding speed that makes it constant throughout the winding process

-Beaming speed increased until it may be up to 100 m/min

-Control on yarn tensile and winding pressure

-The length of yarn on the beam may be between 1000 and 3000 meter, and the maximum diameter is 1250 mm to make it on the carpet weaving machine takes a long period of time so as to provide warping time and periods of breakdowns.

4-1-4- Effect of modern technological development on carpet manufacture process:-

The face to face weaving system was first applied in the carpet industry in the 1920s and has since benefited from a sustained programme of technical development. It has achieved particular access in the growing market for rugs and bordered carpet squares, and is used worldwide to create products ranging from fine and heavy constructions having 3-ply wool pile to cheaper products from BCF polypropylene⁽⁹⁾.

Technological development has helped the development of the modern face to face carpet machines adopted on the basic factors are as illustrated in Figure (3).

1-Advanced electronics:

Where the modern face to face carpet machines were supplied with microprocessor control unit controls all the machine parts and all the mechanical movements such as machine speed, stop motion, lubrication interval and production quantity and analysis it, **so as have been achieved the following advantages:**

- The possibility of producing carpets with many specifications.

- Machine equipped with an electronic control room, which reduces the amount of cabling and time for installations.

-The energy bus system recuperates the kinetic energy for lower power consumption⁽¹⁰⁾.

-Machine is equipped with a computer from which can be:

All designs are stored in the computer memory and can be called at any time to run

Programming the machine by a number of drivers are enough to run the machine for a period of time can be determined by the desire

Controlling on the desired carpet specification by determining number of rows of pile in the unit of measurement.

-The Human Machine interface with touch screen shows the information in a graphical way and programmed by flash card, not sensitive to dust and

vibrations. The controller can easily be integrated network system⁽¹⁰⁾.

- Control the movements of flowing and folding of ground warp yarns electronically, which reduces breakdowns and achieves production quality.

- The Smart Cutting Motion with servomotor allows a very stable cutting and the cutting frequency and sharpening of the knife are programmable⁽¹⁰⁾.

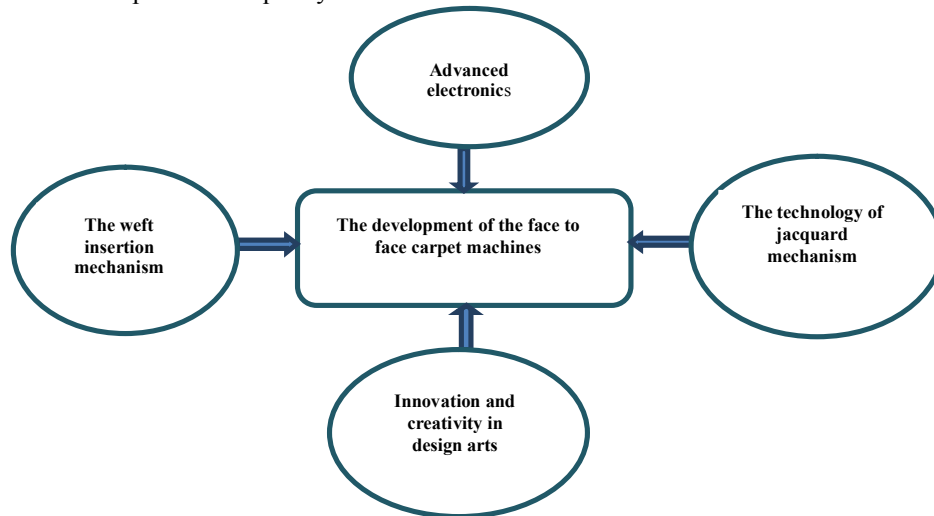


Figure (3): Factors affecting The development of the face to face carpet machines

- The Carpet machine can be equipped with Smart Frames driving the heddle frames by a servomotor, for easy switching between different weave structures. Timing differences, asymmetric motions and dwells guarantees a clean back with less incorporated pile yarns⁽¹⁰⁾.

2-Evolution of Jacquard devices:

-Punched - card jacquards:

first: It is a mechanical jacquard running by paper cards that need a sewing process to connect the cards after punching where each card represents one pile row.

Second: It is a mechanical jacquard running by paper or plastic cards that do not need a sewing process after punching because the cards are connected.

-Electronic jacquards: That do not need any type of cards to running, as the basic idea is based on loading the design after the conversion process (converting design from image to running data for jacquard as already mentioned) on a computer connected to the carpet machine operating from ZIP disk, CD-ROM or network that sends electrical signals to the Jacquard turn into a magnetic signals, the Jacquard turning it into a mechanical powerful that drives warp yarns in vertical movement up and down to accomplish designs required, **which led to the achievement of the following characteristics:**

-Dispensing cards series, whether paper or plastic permanently and what accompanying it from multiple problems and breakdowns.

- Cancel the time required for the installation of a series of cards on the jacquard.

- Reduce production costs due to the shedding cards completely.

-The possibility of changing designs (sizes and colors) quickly and easily.

-Dispensing the place necessary to save cards chains.

-Dispense with mechanical finishing process which during it the removal of warp yarns floating in the back of the carpet (scraping process).

- Current driven solenoids, insensitive to temperature, for low power consumption.

- Simplify the means of connection between the means of raising warp yarns and legs of grid

- Jacquard knives driven by conjugate cams on both sides.

-Reduce the number of jobs that were mechanically lead to simplify parts of the transportation system and the formation of shed-lifting.

-Reduce the necessary power to movement of cylinder and the formation of shed.

-Machine is equipped with touch screen jacquard controller for production planning.

-The possibility of the production of carpet its surface combines cut and loop piles.

-High production by a large margin.

3-The weft insertion mechanism:

That has evolved to include three types are as follows:

Single-rapier.
Double-rapier.
Triple-rapier.

As a result of this development the following features have been achieved:

-Continuous weft insertion from large yarn package, reducing stoppages and eliminating cop winding⁽⁴⁾.

-Smaller shed openings by the small cross-section of the rapiers.

-Higher loom speeds and efficiencies.

-Product carpet has become a very high resistance to erosion by the influence of friction when in use.

4- Innovation and creativity in design arts:

That requires a new design ideas need to a greater number of colors - a new specification that combines pile and flat textile structures - new design ideas using as pendants for fitting on the walls - this in addition to the multiple design sizes, which require non-waste in textile raw materials.

Thanks to these factors the following advantages have been achieved:

- Carpet designs become have an elaborate color effects and fantastic thanks to these mentioned previously developed technology and increase the number of colors on the machine to more than 12 color per dent.

- Production of designs which having different effects containing cut and lop piles.

- The possibility of producing designs with very fine motifs (such as points).

- The possibility of the production of carpets have multiple textile specification.

- The production of carpets would have multiple sizes without wasting production on the machine where the width of the machine arrived to 5.2 meters.

- Benefit from the remnants of pile warp yarns remaining from an earlier production in the production of innovative designs do not appear any color defects⁽¹¹⁾.

- The possibility of producing designs contain symbols, writings and manuscripts.

- Each of the two top and bottom carpets may quite resemble, and may differ as desired without wasting production.

- High functional performance for carpets product due to the high percentage of flexibility for carpets and increased stability on the ground when in use.

4-1-5- Effect of modern technological development on screening and finishing processes of carpets:

Finishing of carpet normally include the following successive steps:

1- Inspection and mending

2- Coating by Latex

3- Drying

4-Brushing and Shearing

Modern technological advances have contributed to the development of these phases which are all became consecutive on a one production line, that led to:

- Provide the time needed to transfer the carpet between these successive stages.

- Providing the necessary effort and space to navigate

- provision in manpower

- Economy in share capital

-With technological development controlling in the drying room became more accurate , where drying temperature is adjusted in the face of pile surface so as not to affect the pile, especially in the case of pile made of synthetic yarns.

4-1-6- Effect of modern technological development onstage of packaging and storage for carpets:

Packaging equipment has evolved with high degree efficiency resulting in:

-Speed in packaging process

-Maintain the appearance of carpet in terms of straightening and do not flatten the carpet pile, especially with increased storage time

Other factors influenced the evolution of the carpet industry:

Modern technological advances in inspection and testing devices of carpet, this lead to:

1-The accurate and scientific ensure that carpet characteristics product have high functional performance when used.

2-Matching the product carpet with the required specifications.

3--Application of quality control related with carpet manufacture.

4-Investigation a high level of consumer satisfaction and achieve his future desires.

4-2- Innovative carpet products by the impact of the sophisticated modern technology:

In recent years, the carpet industry technology has evolved to the super point where carpet production become have a very high special specifications such as:

-Smart carpet:

Which can contain one or more of the following properties (thermal insulation - static electricity resistance - resistance to water absorption and moisture - resistant to stains and oils - resistant to bacteria - resistant to flammable - insect repellents) or with electrical properties such as safety against thefts.

-Hot carpet:

This carpets were developed in Japan, where shoes have traditionally been removed before entering home, to provide comfort to the feet and some ground

heating. they are usually squares, and may be dimensioned in multiples of tatami sizes⁽⁴⁾.

-Luminous carpet:

There is a market in the entertainment sector of the hospitality contract market for carpet that fluoresce. The principal objective is to create designs that become prominent and attractive under the ultraviolet light that is a feature of night clubs and theatres. Fluorescent motifs can also be used to indicate the direction of exits in such darkened environments⁽⁴⁾.

4-3-1-Poll opinions about the most important modern technological factors that influenced the face to face carpet technology:

Questionnaire was designed to explore the opinions of some of the workers in the field of face to face carpet industry (experience of not less than 15 years) on the impact of some factors of the modern technological development on the carpet industry technology. Table (1) and figure (4): shows the model of the questionnaire used in the study.

Table (1): The model of the questionnaire used to assess the impact of some factors of the modern technological development on the carpet industry technology:

These modern technological factors affecting the technology of face to face carpet industry, chose one of the three choices

NO.	Axes of questionnaire	Respondents saw		
		Disagree 0	Agree 1	Strongly agree 2
1	Development of information technology, communication and networking at the local, regional and international level			
2	The use of computers in the carpet design(Computer Aided Design)			
3	New and innovative carpet specifications that are commensurate with the new functional requirements compatible with new technological development and modern life			
4	Modern advanced technology for the manufacture of modern raw materials and textile yarns			
5	Advanced electronics technology applied in the machines industry of carpet production			
6	Advanced technology used in the inspection and reform devices			
7	Developed technology in the field of processing and treatment of carpets to suit particular applications			
8	Advanced technological Measurement and testing devices			
9	The use of modern packaging equipment			

4-3-2-Opinion poll results:

Table (2) shows opinion poll results through the previous questionnaire, and the numbers registered in the table indicate to the percentage recorded for each of nine Axes.

Table (2): The percentage recorded for each Axis from questionnaire:

NO.	Axes of questionnaire	The percentage recorded to each of seven Axes for questionnaire
1	Development of information technology, communication and networking at the local, regional and international level	89
2	The use of computers in the carpet design(Computer Aided Design)	86
3	New and innovative carpet specifications that are commensurate with the new functional requirements compatible with new technological development and modern life	81
4	Modern advanced technology for the manufacture of modern raw materials and textile yarns	81
5	Advanced electronics technology applied in the machines industry of carpet production	100
6	Advanced technology used in the inspection and reform devices	32
7	Developed technology in the field of processing and treatment of carpets to suit particular applications	66
8	advanced technological Measurement and testing devices	46
9	The use of modern packaging equipment	24

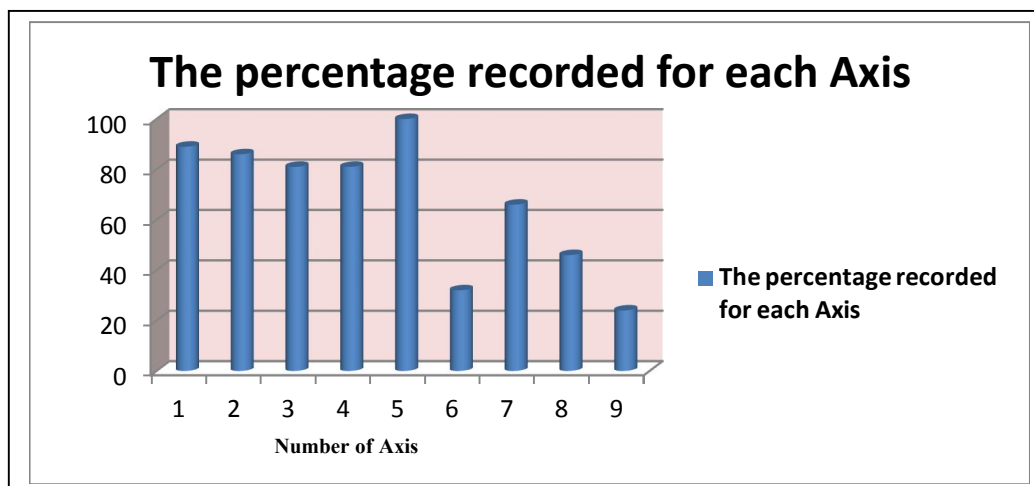


Figure (4): the impact of some factors of the modern technological development on the carpet industry technology

Through the previous figure reflected the following results:

Advanced electronics technology applied in the machines industry of carpet production is the main factor in the development of the carpet technology, where has achieved 100%.

Followed by in second place the axis of development of information technology, communication and networking at the local, regional and international level, where has achieved 89%.

Comes in last ranked the axis of the use of modern packaging equipment.

5-Conclusion:-

Carpet industry is one of the leading industries at the local, regional and global levels, and that the carpet product must be achieves its usability aesthetic and economic functions.

From here was this analytical study about the impact of the use of modern technology in the development of the face to face carpet industry and increase the quality and quantity of the product to satisfy consumer, so that in the present time this type of carpet is considered the largest and most productive and the most commonly used at the local and the global, and what has passed through many stages and successive.

From here the results of this study on the impact of the application of modern technology on the carpet production technology are as follows:

-Easy and speed of accurate scientific studies to the needs of the market.

-The evolution of the field of advertising in the field of carpet and floor covering and open new markets.

-The use of advanced electronics technology and the computer at all stages of the production of carpets

- Creating new designs and modern specifications of carpet commensurate with high functional performance complies with the requirements of modern life.

- The evolution of the production technology of synthetic raw materials and methods of production yarns.

- Update all parts of textile machines and processing equipment

-Production speed and lower costs.

-The application of quality standards in the carpet industry.

The study also showed that the most influential technological factors on the evolution of carpet production technology are:

-Advanced electronics technology applied in the machines industry of carpet production.

-Development of information technology, communication and networking at the local, regional and international level.

- The use of computers in the carpet design.

Modern advanced technology for the manufacture of modern raw materials and textile yarns.

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