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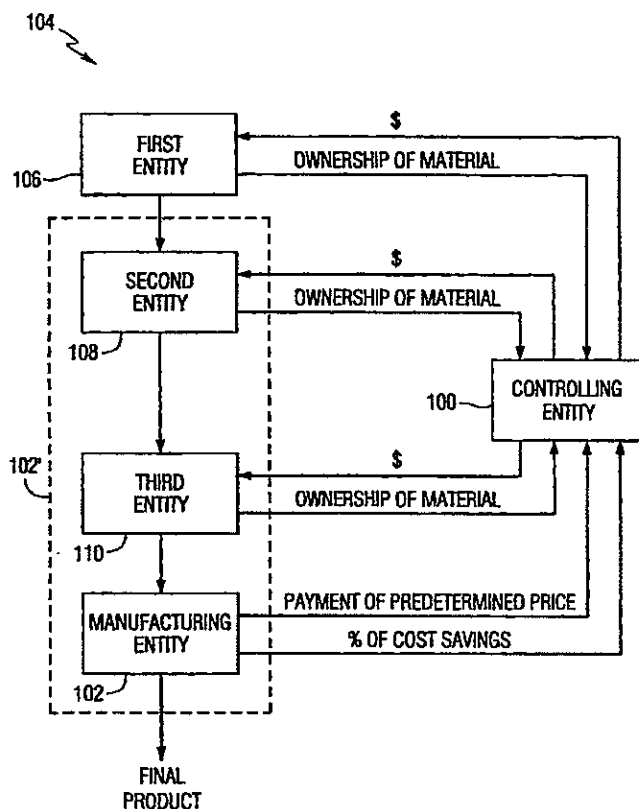
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(54) Title: METHOD OF ALLOCATING COST SAVINGS ASSOCIATED WITH A MANUFACTURING PROCESS



(57) Abstract: The present invention also provides a method of cost savings feedback in a printed circuit board value chain that includes a yarn manufacturer which manufactures fiber glass yarn, a weaver which forms the fiber glass yarn into a fabric, a laminator which forms the fabric into laminate and a printed circuit board (PCB) manufacturer which forms the laminate into a PCB which the PCB manufacturer sells to an OEM customer, the method comprising the steps of (a) having a controlling entity; (b) transferring to the controlling entity at least partial control of fiber glass yarn manufactured by a yarn manufacturer; (c) causing the fiber glass yarn to be delivered to a weaver for weaving into fabric; (d) transferring to the controlling entity at least partial control of fabric formed by the weaver; (e) causing the fabric to be delivered to a laminator for laminating; (f) transferring to the controlling entity at least partial control of laminate formed by the laminator; (g) selling the laminate to a PCB manufacturer at a market price for other laminate formed from other fiber glass yarn; (h) causing the laminate to be delivered to the PCB manufacturer; (i) determining cost savings realized by the PCB manufacturer in response to forming PCBs utilizing the laminate versus utilizing the other laminate formed from the other fiber glass yarn; and (j) allocating at least a portion of the cost savings to the controlling entity.

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**METHOD OF ALLOCATING COST SAVINGS
ASSOCIATED WITH A MANUFACTURING PROCESS**

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BACKGROUND OF THE INVENTION

1. **Field of the Invention**

The present invention relates to a method of allocating cost savings associated with a manufacturing process and, more particularly, to a
10 method of allocating cost savings extracted by a downstream entity to an upstream entity in the printed circuit board value chain.

2. **Description of the Prior Art**

A printed circuit board value chain includes a fiber glass yarn manufacturer which sells fiber glass yarn that includes a starch/oil coating
15 to a fabric weaver. The fabric weaver applies another coating, referred to as a slashing sizing, to enhance the abrasion resistance of the fiber glass yarn. Thereafter, the fabric weaver weaves the fiber glass yarn into a fabric, removes the starch/oil coating and the slashing sizing and applies a resin-compatible sizing to the fabric. Thereafter, the fabric weaver sells
20 the fabric to a laminator who impregnates the fabric with standard and specialized epoxy resins to form laminate. The laminator sells the laminate, by itself or as copper-clad laminate cores, to a printed circuit board (PCB) manufacturer. The PCB manufacturer processes the copper-clad laminate cores to make rigid printed circuit boards or combines layers
25 of laminate and copper-clad laminate cores to make multi-layer PCBs. The PCB manufacturer etches circuit designs onto the surface of the PCBs, and drills and plates through-holes in the PCBs to make electrical connections to original equipment manufacturer (OEM) customers' specifications.

30 The printed circuit board value chain described above includes approximately 2,000 PCB manufacturers worldwide. At the fiber glass yarn manufacturer, fabric weaver and laminator levels, the printed circuit

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board value chain includes four to five major participants at each level supplying a majority of the market demand for their respective levels. However, at each level in the printed circuit board value chain each participant is horizontally and vertically fragmented from the other

5 participants in the printed circuit board value chain.

In the typical printed circuit board value chain, material flows downstream toward the OEM customer and capital, e.g., dollars, flow in a reverse direction, i.e. upstream, with each participant in the printed circuit board value chain purchasing material only from an adjacent upstream

10 participant and/or selling material only to an adjacent downstream participant. In this respect, each participant in the printed circuit board value chain communicates primarily with an adjacent upstream participant and/or an adjacent downstream participant.

Presently, OEM customer demands for lower total system costs are

15 producing a ripple effect through the printed circuit board value chain, resulting in a projected 7 to 9% annual decrease in the price of materials supplied to each participant in the printed circuit board value chain, particularly laminates. Consequently, the pricing environment within the printed circuit board value chain is intense, and any price increases or

20 products sold at price premiums, regardless of product performance, are almost completely ignored. This problem is exasperated by the current worldwide overcapacity for materials, particularly fiber glass yarn, fabric and laminate.

The foregoing pricing environment and the horizontal and vertical

25 fragmentation of the printed circuit board value chain coact to produce an environment where there is little or no incentive to produce and sell new materials or products, such as fiber glass yarn, that will benefit the OEM customers while at the same time not increase the market price paid by the PCB manufacturer for laminate. Hence, within the current printed

circuit board value chain the producer of a new material must settle for market share gain in an effort to recover costs and realize a profit.

It is, therefore, an object of the present invention to overcome the above problems and others by providing a method of allocating cost savings realized by a participant in a value chain to other selected participants in the value chain, and more specifically a method of allocating to an upstream participant in the printed circuit board value chain cost savings realized and extracted by a downstream participant in the printed circuit board value chain so as to share a portion of the cost savings with the upstream participant. It is also an object of the present invention to provide a business structure that encourages new product development and which provides for cost recovery of new product development from savings realized by downstream participants in a fragmented and cost-sensitive processing chain. Still, other objects of the present invention will become apparent to those of ordinary skill in the art upon reading and understanding the following detailed description.

SUMMARY OF THE INVENTION

The present invention provides a method of allocating cost savings in a printed circuit board value chain comprising the steps of (a) having a controlling entity; (b) causing a laminate incorporating a fiber glass yarn to be delivered to an entity that causes the manufacture of a printed circuit board (PCB); (c) causing the manufacture of PCBs; and (d) allocating at least a portion of cost savings realized from the manufacture of the PCBs to the controlling entity. In one embodiment of the invention, the causing step (b) is controlled by the controlling entity. The method can further include the step of determining cost savings realized from the manufacturer of PCBs utilizing the laminate in step (b) versus utilizing laminate different from the laminate of step (b).

The present invention further provides a method of allocating cost savings in a printed circuit board value chain comprising the steps of: (a)

having a controlling entity; (b) causing a laminate incorporating a fiber glass yarn to be delivered to an entity that causes manufacture of a printed circuit board (PCB); (c) causing the manufacture of PCBs in a manner that results in a cost savings; and (d) allocating at least a portion
5 of the cost savings realized from the manufacture of the PCBs to the controlling entity.

The present invention also provides a method of allocating cost savings in a printed circuit board value chain comprising the steps of: (a) having a controlling entity; (b) causing a fiber glass yarn in a
10 predetermined form to be delivered to a printed circuit board (PCB) manufacturer; (c) the PCB manufacturer causing the fiber glass yarn to be incorporated into a laminate; (d) the PCB manufacturer causing manufacture of PCBs; and (e) allocating at least a portion of cost savings realized from the manufacture of PCBs to the controlling entity.

15 The present invention further provides a method of allocating cost savings in a printed circuit board value chain comprising the steps of: (a) having a controlling entity; (b) causing a fiber glass yarn in a predetermined form to be delivered to a printed circuit board (PCB) manufacturer; (c) the PCB manufacturer causing the fiber glass yarn to be
20 incorporated into a laminate; (d) the PCB manufacturer causing manufacture of PCBs in a manner that results in a cost savings; and (e) allocating at least a portion of cost savings realized from the manufacture of PCBs to the controlling entity.

The present invention further provides a method of allocating cost
25 savings in a printed circuit board value chain comprising the steps of: (a) having a controlling entity; (b) causing fiber glass yarn to be manufactured; (c) causing the fiber glass yarn to be woven into fabric; (d) causing the fabric to be incorporated into a laminate; (e) causing the laminate to be delivered to an entity that causes the manufacture of printed circuit boards
30 (PCB); (f) causing manufacture of PCBs; and (g) allocating at least a portion of cost savings realized from the manufacture of PCBs to the

controlling entity. In various embodiments of the invention, at least one of steps (b), (c), (d) and (e) are controlled by either the controlling entity or the PCB manufacturer.

The present invention also provides a method of allocating cost savings in a printed circuit board value chain comprising the steps of: (a) having a controlling entity; (b) causing fiber glass yarn to be manufactured; (c) causing the fiber glass yarn to be woven into fabric; (d) causing the fabric to be incorporated into a laminate; (e) causing the laminate to be delivered to an entity that causes the manufacture of printed circuit boards (PCB); (f) causing manufacture of PCBs in a manner that results in a cost savings; and (g) allocating at least a portion of cost savings realized from the manufacture of PCBs to the controlling entity.

The present invention also provides a method of allocating cost savings in a printed circuit board value chain that includes a yarn manufacturer which manufactures fiber glass yarn, a weaver which forms the fiber glass yarn into a fabric, a laminator which forms the fabric into laminate and a printed circuit board (PCB) manufacturer which forms the laminate into a PCB which the PCB manufacturer sells to an OEM customer, the method comprising the steps of (a) having a controlling entity; (b) transferring to the controlling entity at least partial control of fiber glass yarn manufactured by a yarn manufacturer; (c) causing the fiber glass yarn to be delivered to a weaver for weaving into fabric; (d) transferring to the controlling entity at least partial control of fabric formed by the weaver; (e) causing the fabric to be delivered to a laminator for laminating; (f) transferring to the controlling entity at least partial control of laminate formed by the laminator; (g) selling the laminate to a PCB manufacturer at a market price for other laminate formed from other fiber glass yarn; (h) causing the laminate to be delivered to the PCB manufacturer; (i) determining cost savings realized by the PCB manufacturer in response to forming PCBs utilizing the laminate versus utilizing the other laminate formed from the other fiber glass yarn; and (j)

allocating at least a portion of the cost savings to the controlling entity. In one embodiment of the invention, to determine the cost savings realized by the PCB manufacturer from forming PCBs utilizing the laminate versus utilizing the other laminate, the PCB manufacturer forms a first plurality of
5 PCBs utilizing the laminate, forms a second plurality of PCBs utilizing the other laminate, determines cost savings from forming the first plurality of PCBs utilizing the laminate versus forming the second plurality of PCBs utilizing the other laminate, and applies the determined cost savings to third and subsequent pluralities of PCBs formed utilizing the laminate.

10 The present invention also provides a method of new product cost recovery in the production and distribution of fiber glass yarn formed in printed circuit boards (PCBs), the method comprising the steps of: (a) transferring at least partial control of fiber glass yarn from a first, fiber glass yarn-producing entity to a second, controlling entity; (b) transferring
15 possession of the fiber glass yarn to a third, fabric-producing entity at the direction of the second, controlling entity; (c) forming the fiber glass yarn into a fabric; (d) transferring possession of the fabric from the third entity to a fourth, laminate-producing entity at the direction of the second, controlling entity; (e) forming the fabric into a laminate; (f) transferring
20 possession of the laminate from the fourth entity to a fifth, PCB-producing entity at the direction of the second, controlling entity; (g) forming the laminate into PCBs; (h) determining cost savings realized by the fifth entity in response to forming the PCBs utilizing the laminate versus utilizing another laminate formed from another fiber glass yarn; and (i) allocating
25 the cost savings to the second, controlling entity. In one embodiment of the invention, the determination of cost savings can be realized from, among other things, extending drill-bit life, increasing laminate stack-up height, reducing laminate waste, reducing laminate utilization due to increased density of component mounting, reducing migration of metal
30 adhered on the laminate versus laminate formed from the other fiber glass yarn, improving through-hole positioning tolerance and/or improving PCB

manufacturing productivity.

The present invention further provides a method of cost savings extracted by a downstream entity in a value-added processing chain with an upstream entity in the processing chain cost savings the method

5 comprising the steps of: (a) producing a material in a first form; (b) supplying the material in the first form from a first entity to a second entity; (c) processing the material from the first form into a second form having greater commercial value than the first form; (d) supplying the material in the second form to a third entity; (e) processing the material

10 from the second form into a third form having greater commercial value than the second form; (f) quantifying cost savings realized by the third entity in response to processing the material from the second form into the third form versus the third entity processing another material from the second form into the third form; (g) extracting the cost savings; and (h)

15 allocating at least a portion of the extracted cost savings to the first entity.

The present invention also provides a computer-implemented method for allocating cost savings associated with a manufacturing process, comprising : (a) realizing a cost savings associated with using a process for manufacturing a product from a starting component

20 associated with a source as compared with using the process for manufacturing the product from a different starting component; and (b) allocating at least a portion of the cost savings to the source.

The present invention further provides a computer-implemented method for allocating cost savings associated with a manufacturing

25 process, comprising: (a) monitoring a process for manufacturing a product from a starting component associated with a source and generating cost data associated with the process; (b) comparing the generated data with stored data reflecting a cost of manufacturing the product from a starting component that is different from the starting component used in the monitored process; and (c) allocating at least a portion of a cost savings

30 associated with the monitored process based on the comparison to the

source.

The present invention further provides a computer-implemented method for allocating cost savings associated with a manufacturing process, comprising: (a) monitoring a process for manufacturing a product
5 from a starting component associated with a source and generating cost data associated with the process; (b) realizing a cost savings associated with employing the monitored process as compared with another process for manufacturing the product from a starting component that is different from the starting component used in the monitored process; and (c)
10 allocating at least a portion of a cost savings to the source.

The present invention also provides a computer-implemented method for determining cost savings associated with a manufacturing process, comprising: (a) receiving data reflecting a first process of manufacturing a product from a starting component associated with a
15 source; (b) comparing the received data reflecting with stored data reflecting at least one other process of manufacturing the product from a starting component that is different from the starting

component used to manufacture the product of the first process; and (c) allocating at least a portion of a cost savings associated with using the first process based on the comparison to the source.

5 **BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 is a flow chart of a prior art printed circuit board value chain with exemplary revenue amounts for discussion purposes;

Fig. 2 is a flow chart of a printed circuit board value chain in accordance with one embodiment of the present invention;

10 Fig. 3 is a flow chart of a printed circuit board value chain in accordance with another embodiment of the present invention;

Fig. 4 is a flow chart of a printed circuit board value chain in accordance with yet another embodiment of the present invention; and

Fig. 5 is a flow chart of a value chain similar to Fig. 3.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to Fig. 1, a prior art printed circuit board (PCB) value chain 2 includes a fiber glass yarn producing entity or a manufacturer 4, which produces continuous strand fiber glass yarns that are marketed and sold to a fabric weaver 6, which weaves the yarn into a fabric that is sold to laminate producing entity or laminator 8, which forms prepregs and laminates that are sold to a PCB producing entity or manufacturer 10 which forms printed circuit boards. For the sake of clarity, as described herein, product moves through in the value chain from an upstream entity toward a downstream entity. For example, in Figure 1, the fiber glass yarn manufacturer 4 would be an upstream entity relative to the weaver 6, laminator 8 and PCB manufacturer 10. Furthermore, the weaver 6 would be a downstream entity relative to the fiber glass yarn manufacturer 4 and an upstream entity relative to laminator 8 and PCB manufacturer 10.

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The fiber glass yarns produced by the fiber glass yarn manufacturer 4 typically include a starch/oil coating that provides protection against interfilament abrasion and contact abrasion during weaving of the fiber glass yarns into electronic grade fabrics. The starch/oil coating also enables the yarns to be woven at high speeds, for example on air jet looms, by providing high air drag at low air pressure and high contact lubrication to offset friction between the fiber glass yarns and rapid-action loom-feeding mechanisms.

Fabric weaver 6 typically coats the fiber glass warp yarn with a secondary coating in a process known in the art as slashing. This secondary coating, or slashing sizing, is formed over the starch/oil coating on the fiber glass warp yarns received from the fiber glass yarn manufacturer 4 and improves the abrasion resistance of the fiber glass warp yarn during weaving of the yarns into fabric.

Once the slashing sizing has been applied, fabric weaver 6 weaves the fiber glass yarn into fabric. The fabric is then heat cleaned or chemically cleaned to remove the starch/oil coating and the slashing sizing. The cleaned fabric then receives a resin-compatible sizing and is thereafter supplied to a laminator 8 for lamination.

Laminator 8 processes the fabric through treaters that impregnate the fabric with standard and specialized resins, and in particular epoxy resin. Laminator 8 then sells the impregnated fabric after it is partially cured directly to a PCB manufacturer 10. Laminator 8 can also adhere sheets of copper, or other electrically conductive material, to one or both sides of a impregnated fabric or to a stack of impregnated fabric to form copper-clad fabric-impregnated cores which are utilized by PCB manufacturer 10 to form multi-layer PCBs.

PCB manufacturer 10 processes copper-clad laminate of one or more impregnated fabrics to make rigid printed circuit boards or combines sheets of impregnated fabric and copper-clad fabric impregnated cores to

make multi-layer PCBs. PCB manufacturer 10 etches the circuits onto the surface of the PCBs, and drills and plates through-holes in the PCBs to make electrical connections.

As shown in Fig. 1, each participant in PCB value chain 2 adds value to the fiber glass yarn. Specifically, fiber glass manufacturers, represented by fiber glass yarn manufacturer 4, realize about \$500 million in annual revenue worldwide from producing continuous strand fiber glass yarns that are marketed and sold to weavers of electronic grade fabrics. Fabric weavers, represented by fabric weaver 6, realize about \$1.1 billion in annual revenue worldwide from forming the continuous strand fiber glass yarns into fabric. Laminators, represented by laminator 8, realize about \$5 billion in annual revenue worldwide from forming the fabric into laminate and/or copper-clad fabric-impregnated cores. Lastly, PCB manufacturers, represented by PCB manufacturer 10, realize about \$33.2 billion in annual revenue worldwide from manufacturing PCBs to OEM customer specifications and selling the PCBs to the OEM customer or its contract assembler. As shown in Fig. 1, the flow of value-added fiber glass yarn is downstream in PCB value chain 2 while the flow of capital, e.g., dollars, is upstream, with each participant of PCB value chain 2 delivering product to and receiving capital from only its immediately preceding downstream participant.

Currently, there are approximately 2,000 PCB manufacturers worldwide. In contrast, at the fiber glass manufacturer, fabric weaver and laminator levels, the PCB value chain 2 includes four to five major participants at each level supplying a majority of the market demand for their respective segments of PCB value chain 2.

OEM customers of PCBs pressure the PCB manufacturers to reduce the total cost of systems produced by the PCB manufacturers. This pressure has impacted every participant of PCB value chain 2 with a resulting projected 7 to 9% annual decrease in the price of PCB

components, particularly laminates. Hence, there is little or no incentive for any participant in PCB value chain 2 to introduce new materials or products at price or cost premiums, since OEM customers purchasing PCBs will not tolerate these increases and a producer of such new materials or products will not be compensated for their development efforts or realize a profit thereon. In the present PCB value chain 2, the OEM customer and ultimate consumer do not benefit from the introduction of new and improved products. Further exasperating this problem is an increase worldwide in new capacity that has resulted in industry overcapacity for fiber glass yarn, fabric and laminate.

With reference to Fig. 2, and with ongoing reference to Fig. 1, the present invention is a method of allocating or distributing cost savings associated with a manufacturing process and more particularly, a method of allocating cost savings realized by a downstream participant to an upstream participant in a PCB value chain 2' so as to share least a portion of the cost savings with the upstream participant. This allocation of cost savings enables the upstream participant to produce new material or products that benefit downstream participants or customers of PCBs while enabling the upstream participant to share at least part of the benefit realized by the downstream participants. In the method, PCB value chain 2 shown in Fig. 1 is adapted to PCB value chain 2' shown in Fig. 2 by including in PCB value chain 2 a PCB value chain controlling entity 12 (hereinafter "controlling entity") that is designated or identified to manage the movement of the fiber glass through at least a portion of the PCB value chain. As will be discussed later in more detail, in the present invention, cost savings associated with a process of manufacturing printed circuit boards from a starting component (e.g. a new fiber glass yarn) associated with a source (e.g. controlling entity 12) as compared with using the process for manufacturing printed circuit boards from a different starting material are realized and at least a portion

of the cost savings is allocated to the source. Without limiting the present invention, in one particular embodiment, controlling entity 12 is a subsidiary or division of fiber glass yarn manufacturer 4. However, controlling entity 12 can be established as an entity related to fabric weaver 6, laminator 8 or PCB manufacturer 10, or unrelated to any participant of PCB value chain 2'.

Initially, fiber glass yarn manufacturer 4 produces a new fiber glass yarn having improved performance characteristics (described hereinafter) over conventional fiber glass yarns. In PCB value chain 2 of Fig. 1, fiber glass yarn manufacturer 4 would not be able to realize a return on investment, or a profit, from producing the new fiber glass yarn. However, the improved performance characteristics enable cost savings to be realized by participants downstream in PCB value chain 2' shown in Fig. 2. In the embodiment shown in Fig. 2, controlling entity 12 causes the fiber glass yarn to be manufactured, e.g. by entering into an agreement with the fiber glass yarn manufacturer 4, whereby controlling entity 12 purchases the new fiber glass yarn from fiber glass yarn manufacturer 4 at market price for the new fiber glass yarn.

Controlling entity 12 then causes the yarn to be formed into a fabric, e.g. by entering into a tolling agreement or contract manufacturing agreement with the fabric weaver 6, whereby fabric weaver 6 receives the new fiber glass yarn from controlling entity 12, forms the new fiber glass yarn into fabric and supplies the fabric to controlling entity 12. In consideration for forming the new fiber glass yarn into fabric, controlling entity 12 pays fabric weaver 6 an agreed-upon tolling fee. Preferably, this payment releases any lien fabric weaver 6 may have on the fabric for increasing the value of the new fiber glass yarn by forming it into the fabric and the controlling entity 12 will have physical possession of the fabric as well as complete control over and ownership of the fabric.

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Controlling entity 12 then causes the fabric to be incorporated into a laminate, e.g. by entering into a tolling agreement or contract manufacturing agreement with the laminator 8, whereby laminator 8 receives fabric from controlling entity 12, forms the fabric into laminate and/or copper-clad laminate cores (hereinafter collectively referred to as "laminate") and supplies the laminate to controlling entity 12. In consideration for forming the fabric into laminate, controlling entity 12 pays laminator 8 an agreed-upon tolling fee. Preferably, this payment releases any lien laminator 8 may have on the laminate for increasing the value of the new fiber glass yarn by forming the fabric into laminate and the PCB value chain controller 12 will have physical possession of the laminate as well as complete control over and ownership of the laminate.

Lastly, controlling entity 12 causes printed circuit boards to be manufactured, e.g. by selling the laminate to PCB manufacturer for processing into PCBs for OEM customers. Without limiting the present invention, in one embodiment, controlling entity 12 sells the laminate to the PCB manufacturer 10 at a market price which is equal to the price typically paid by the PCB manufacturer 10 for laminates incorporating conventional starch/oil sized glass fibers. The payment received by controlling entity 12 is used to pay the tolling fees to fabric weaver 6 and laminator 8 and to pay fiber glass yarn manufacturer 4 for the new fiber glass yarn.

Although not required, preferably, controlling entity 12 purchases the new fiber glass yarn from fiber glass yarn manufacturer 4 and retains ownership of the new fiber glass yarn and product incorporating the fiber glass yarn until the laminate is sold to PCB manufacturer 10.

As discussed above, the new fiber glass yarn purchased by controlling entity 12 preferably has properties, i.e., improved performance characteristics, that enable fabric weaver 6, laminator 8 and/or PCB manufacturer 10 to realize cost savings versus utilizing conventional fiber

glass yarn. Although not limiting in the present invention, these improved properties can result from the fibers being a new glass composition and/or applying a new coating or sizing composition to at least a portion of the surface of the glass fibers after they are formed and/or applying a new

5 coating composition to at least a portion of the surface of the fiber glass fabric. For example, the assignee of the present invention produces a new fiber glass yarn, referred to as "Hybon™ RCY Yarn". Laminates formed from Hybon RCY Yarn have the potential to reduce metal migration, improve flexural strength, improve hydrolytic stability, improve

10 shear strength and improve time-to-blister. Moreover, laminates formed from Hybon RCY Yarn also have the potential to reduce drill-bit wear, improve drill hole positioning tolerance and improve manufacturing productivity. The foregoing reduction and improvements enable one or more participants of PCB value chain 2, particularly PCB manufacturer 10,

15 to realize cost savings from using laminates incorporating the new fiber glass yarn versus using another laminate incorporating conventional starch-oil sized fiber glass yarn.

In order for controlling entity 12 to realize income from cost savings realized by PCB manufacturer 10 from using laminate incorporating the

20 new fiber glass yarn, such as Hybon RCY Yarn, controlling entity 12 and PCB manufacturer 10 enter into an agreement whereby controlling entity 12 sells laminate to PCB manufacturer 10 at market price for conventional laminate and PCB manufacturer 10 allocates at least a portion of any realized cost savings to controlling entity 12. More specifically, the

25 agreement between controlling entity 12 and PCB manufacturer 10 provides that controlling entity 12 receives additional payment from PCB manufacturer 10 only if PCB manufacturer 10 realizes cost savings from using the laminate incorporating the new fiber glass yarn. Hence, controlling entity 12 realizes operating revenue and profit from a portion

of the cost savings realized by PCB manufacturer 10 in the forming laminate incorporating the new fiber glass yarn into PCBs.

In order for fiber glass yarn manufacturer 4 to recover the cost of developing and producing the new fiber glass yarn and to realize profit thereon, controlling entity 12 can allocate part of the cost savings received from PCB manufacturer 10 to fiber glass manufacturer 4 in order to further share this cost savings.

It should be appreciated that if desired, a portion of the cost savings can be allocated with other participants in value chain 2' in order to further share the cost savings. Without limiting present invention, this can be done, for example, by the controlling entity 12 allocating or distributing a portion of the cost savings received from the PCB manufacturer 10 to other selected participants, or the agreement between the PCB manufacturer 10 and controlling entity 12 can allocate a portion of the cost savings to selected value chain participants.

PCB manufacturer 10 and/or controlling entity 12 quantify or determine the cost savings PCB manufacturer 10 will realize in response to forming PCBs using laminate formed from the new fiber glass yarn versus using another laminate formed from conventional fiber glass yarn. The cost savings can be determined in a number of ways. For example, and without limiting the present invention, PCB manufacturer 10 monitors the costs associated with forming a first plurality of PCBs utilizing laminate formed from the new fiber glass yarn. PCB manufacturer 10 also monitors to costs associated with forming a second plurality of PCBs using the other laminate formed from conventional starch-oil sized fiber glass yarn. It should be appreciated that the costs associated with the manufacture of PCBs using laminate formed from conventional starch-oil sized fiber glass yarn can also be based on historical data previously collected by the PCB manufacturer 10. Next, PCB manufacturer 10 determines cost savings from forming the first plurality of PCBs utilizing

the laminate formed from the new fiber glass yarn versus forming the second plurality of PCBs using the other laminate formed from conventional fiber glass yarn by comparing the data generated while monitoring the manufacture of the PCBs. The determined cost savings
5 are then applied to third and subsequent pluralities of PCBs formed by PCB manufacturer 10 utilizing laminate formed from the new fiber glass yarn. Pursuant to the agreement between PCB manufacturer 10 and controlling entity 12, PCB manufacturer 10 shares the cost savings with controlling entity 12 by allocating at least a portion, e.g. 50%, of the cost
10 savings to the controlling entity 12.

The cost savings and allocation can also be determined and implemented by other methods, such as but not limited to, estimating manufacturing costs or using a computer-implemented method that monitors a process for manufacturing a product from a starting
15 component associated with a source and generates cost data associated with the process, compares the generated data with stored data reflecting a cost of manufacturing the product from a starting component that is different from the starting component used in the monitored process, and allocates at least a portion of a cost savings associated with the
20 monitored process based on the comparison to the source. In an alternate embodiment of the present invention, the computer-implemented method monitors a process for manufacturing a product from a starting component associated with a source and generates cost data associated with the process, realizes a cost savings associated with employing the
25 monitored process as compared with another process for manufacturing the product from a starting component that is different from the starting component used in the monitored process, and allocates at least a portion of the cost savings to the source. In yet another embodiment of the invention, the computer-implemented method receives data reflecting a
30 first process of manufacturing a product from a starting component

associated with a source, compares the received data with stored data reflecting at least one other process of manufacturing the product from a starting component that is different from the starting component used to manufacture the product of the first process, and allocates a cost savings
5 associated with using the first process based on the comparison.
Although not limiting in the present invention, with respect to the embodiments of the invention disclosed above, "a process for manufacturing a product" is the process for manufacturing printed circuit boards, "a starting component" is the new fiber glass yarn, and "a
10 source" is the controlling entity 12.

The cost savings in manufacturing the printed circuit boards can be allocated to the controlling entity 12 in any convenient manner. For example, and without limiting the present invention, the controlling entity 12 can receive a payment prior to the actual realization of the cost
15 savings based on the estimated cost savings, or the controlling entity 12 can receive payment based on anticipated or actual savings on a per laminate basis (for example, a royalty), or the controlling entity 12 can be paid after the actual cost savings are realized. In addition, the cost savings can be allocated using a combination of these payments. For
20 example and not limiting in the present invention, the controlling entity 12 can receive an initial payment from the PCB manufacturer 10 based on a portion of the anticipated savings and a second payment based on a portion of the actual savings.

Another embodiment of PCB value chain 2'' in accordance with the
25 present invention is shown in Fig. 3. In this embodiment, controlling entity 12 purchases and therefore takes at least partial control of the new fiber glass yarn from fiber glass yarn manufacturer 4. More specifically, the controlling entity 12 takes ownership of the new fiber glass, yarn but does not take physical possession of the new fiber glass yarn. Rather, the
30 controlling entity 12 directs fiber glass yarn manufacturer 4 to deliver the

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new fiber glass yarn to fabric weaver 6. When fabric weaver 6 completes processing the new fiber glass yarn into fabric, controlling entity 12 pays fabric weaver 6 the agreed-upon tolling fee for forming the new fiber glass yarn into fabric and gets at least partial control, i.e. ownership of the
5 fabric, while the fabric weaver 6 maintains physical possession of the fabric. This payment releases any lien fabric weaver 6 may have on the fabric.

Next, controlling entity 12 causes the fabric to be delivered from the fabric weaver 6 to laminator 8, for processing into laminate. When
10 laminator 8 completes forming the fabric into laminate, controlling entity 12 pays laminator 8 the agreed-upon tolling fee for processing the fabric into laminate and gets at least partial control, i.e. ownership of the fabric, while the laminator 8 maintains physical possession of the laminate. This payment releases any lien laminator 8 may have on the laminate.

15 Next, controlling entity 12 causes the laminate to be delivered from laminator 8 to an entity that causes the manufacture of a printed circuit board, e.g. PCB manufacturer 10, pursuant to a sale of the laminate from controlling entity 12 to PCB manufacturer 10. In response to receiving the laminate from laminator 8, PCB manufacturer 10 pays controlling
20 entity 12 market price for the laminate. As discussed above, the market price paid by PCB manufacturer 10 for the laminate can be equal to the price typically paid by the PCB manufacturer 10 for laminates incorporating conventional starch/oil sized glass fibers and is used by controlling entity 12 to pay the tolling fees to fabric weaver 6 and
25 laminator 8, and to pay fiber glass manufacturer 4 the market price for the new fiber glass yarn.

As discussed above with respect to value chain 2', prior to receiving the laminate formed from the new fiber glass yarn from laminator 8, PCB manufacturer 10 and controlling entity 12 enter into an
30 agreement whereby, in consideration for paying market price for the

laminates, PCB manufacturer 10 allocates to controlling entity 12 at least a portion of any cost savings realized from using the laminates formed from the new fiber glass yarn. Controlling entity 12 realizes operating revenue and profit from the portion of the cost savings received from PCB

- 5 manufacturer 10. In order for fiber glass yarn manufacturer 4 to recover the cost of producing the new fiber glass yarn and to realize profit thereon, controlling entity 12 can allocate part of the cost savings received from PCB manufacturer 10 to fiber glass manufacturer 4 in order to share the cost savings with the fiber glass manufacturer 4.

- 10 Another embodiment of a PCB value chain 2''' in accordance with the present invention is shown in Fig. 4. In this embodiment, controlling entity 12, as an agent of fiber glass yarn manufacturer 4, enters into the tolling agreements with fabric weaver 6 and laminator 8 on behalf of fiber glass yarn manufacturer 4. Moreover, fiber glass yarn manufacturer 4
- 15 retains ownership of the new fiber glass yarn, as well as ownership of the fabric and laminates, until the laminates are sold to PCB manufacturer 10, while physical possession of the yarn, fabric and laminates passes from the yarn manufacturer 4 to fabric weaver 6 to laminator 8, respectively. Fiber glass yarn manufacturer 4 pays the tolling fees to fabric weaver 6 and
- 20 laminator 8 at the direction of controlling entity 12, thereby, releasing all liens by fabric weaver 6 and laminator 8 for forming the new fiber glass yarn into fabric and the fabric into laminates.

- A communication line 14 from controlling entity 12 to fiber glass yarn manufacturer 4 represents the right of controlling entity 12 to direct
- 25 fiber glass yarn manufacturer 4 to deliver the new fiber glass yarn to fabric weaver 6. A communication line 16 represents the right of controlling entity 12 to direct fabric weaver 6 to deliver fabric to laminator 8. Lastly, a communication line 18 represents the right of controlling entity 12 to direct laminator 8 to deliver laminates to PCB manufacturer
- 30 10. Communication line 14 also represents the right of controlling entity

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12 to direct fiber glass yarn manufacturer 4 to pay the tolling fees to fabric weaver 6 and laminator 8.

In response to receiving laminate formed from the new fiber glass yarn, PCB manufacturer 10 pays controlling entity 12 or fiber glass
5 manufacturer 4 market price for the laminate. If controlling entity 12 receives the market price payment from PCB manufacturer 10, controlling entity 12 forwards this payment to fiber glass manufacturer 4. Thereafter, PCB manufacturer 10 allocates to controlling entity 12 a portion of the cost savings realized in response to forming PCBs utilizing
10 laminate formed from the new fiber glass yarn versus using other laminate formed from conventional starch-oil sized fiber glass yarn in order to share the cost savings with the controlling entity 12. Controlling entity 12 realizes operating revenue and profit from the portion of the cost savings received from PCB manufacturer 10. Controlling entity 12 shares a
15 portion of the cost savings received from PCB manufacturer 10 with fiber glass manufacturer 4 by allocating a portion of the cost savings to the fiber glass manufacturer 4.

As discussed above, PCB value chain controller 12 is preferably an entity such as, without limitation, a division, subsidiary or agent of fiber
20 glass yarn manufacturer 4. However, controlling entity 12 can also be an entity separate from fiber glass yarn manufacturer 4, or fiber glass manufacturer 4 can incorporate the functions of controlling entity 12 within its operations. Where the functions of controlling entity 12 are incorporated within fiber glass yarn manufacturer 4, the communication
25 lines 14, 16 and 18 in Fig. 4 can be eliminated and fiber glass yarn manufacturer 4 receives directly the market price paid by PCB manufacturer 10 for laminate and the portion of the cost savings realized by PCB manufacturer 10.

Based on the foregoing, it can be seen that the present invention
30 enables new fiber glass yarns to be produced and introduced into PCB

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value chains 2', 2'' and 2''' at current market prices while enabling fiber glass yarn manufacturer 4 to realize a payback and other economic benefits for producing and introducing the new fiber glass yarn.

It should be appreciated that although the yarn manufacturer 4, fabric weaver 6, laminator 8 and PCB manufacturer 10 as discussed above are presented as separate and distinct entities, two or more of these entities may be controlled by and/or be part of a single larger entity so that the controlling entity 12 need only cause delivery of the fiber glass in a predetermined form to the single larger entity. For example, and without limiting the present invention, the controlling entity 12 can deal with an entity that is vertically integrated to the extent that it controls its own weaving, laminating and PCB manufacturing operations. In such an instance, controlling entity 12 would only have to deliver or cause to be delivered to the single entity the new fiber glass yarn. Transfer of the new fiber glass yarn and associated products through the value chain would be handled internally by the single entity. In a manner similar to that discussed earlier, the controlling entity 12 and single entity would enter into an agreement whereby the single entity would allocate at least a portion of the cost savings realized by the single entity which are attributable to the use of the new fiber glass to the controlling entity 12 so that the controlling entity 12 could share in the cost savings. If the single entity included only laminating and PCB manufacturing capabilities, the controlling entity 12 need only cause delivery of the fiber glass yarn in the form of a fabric to the single entity.

The invention as discussed above focuses on the cost savings by the PCB manufacturer 10. However, it should be appreciated that controlling entity 12 can also share in the cost savings of the other entities in the value chain. For example and without limiting the present invention, the fabric weaver 6 may realize a cost savings in weaving fabric incorporating the new fiber glass yarn because there is no need to apply a

slashing size to the warp yarn prior to weaving, nor is heat cleaning of the woven fabric and subsequent application of a resin compatible sizing required. The fabric weaver 6 and the controlling entity 12 can enter into an agreement which allocates a portion of the cost savings realized by the fabric weaver 6 which is attributable to using the new fiber glass yarn to the controlling entity 12.

The present invention as disclosed above is discussed in the context of a controlling entity 12 in a PCB value chain sharing in the cost savings of a PCB manufacturer 10 by allocating at least a portion of the cost savings to the controlling entity 12. However, it should be appreciated that the method of allocating cost savings realized by a participant in a value chain with other selected participants in the value chain, and more particularly allocating cost savings extracted by a downstream entity with an upstream entity as disclosed herein is not limited to the particular value chain discussed above. More particularly, as illustrated in Figure 5, a controlling entity 100 controls a new material that when used by manufacturing entity 102 at the end of value chain 104 to manufacture a final product will result in cost savings by manufacturing entity 102. In order for the material to be used by manufacturing entity 102, it may be required to go through a series of processing steps whereby the material is initially made by a first entity 106, passes through the value chain 104 and is converted by a second entity 108 and if required a third entity 110 into different forms. Although not required, each time the material is converted to a different form, it has a commercial value at least equal to and preferably greater than its previous form. The progress of the material through the value chain 104 is controlled by controlling entity 100 and can be effected in a manner similar to that discussed earlier with respect to Figures 2-4. Although not limiting in the present invention, the control by controlling entity 100 as illustrated in Figure 5 is similar to that disclosed earlier in connection with

value chain 2'' and Figure 3. The converted material is delivered to manufacturing entity 102 in a desired form under an agreement between controlling entity 100 and manufacturing entity 102 whereby manufacturing entity 102 pays a predetermined price for the material and
5 further agrees to allocate at least a portion of any cost savings realized by manufacturing entity 102 resulting from its use of the material to controlling entity 100. In this manner, controlling entity 100 can share the cost savings attributable with its product with a downstream user of the material.

10 As discussed earlier, several of the intermediate processing steps of the material can be controlled by a single entity as indicated by dotted line 102'. In this type of value chain, controlling entity 100 would deliver the material or cause the material to be delivered to entity 102' who in turn would perform the necessary material conversion(s) and allocate a portion
15 of any cost savings realized by entity 102' in the manufacture of the final product to the controlling entity 100 so that the controlling entity 100 can share in the cost savings.

It should also be appreciated that controlling entity 100 can deliver new material which will result in cost savings directly to a processing
20 entity, e.g. a customer (not shown), who uses the material in its process to manufacture a final product without any prior conversion or modification of the material. More specifically, controlling entity 100 and the processing entity enter into an agreement whereby the processing entity purchases the material at a predetermined cost, e.g. the cost of
25 conventional material, and any cost savings realized by the processing entity attributable to its use of the material will be shared with the controlling entity 100 by allocating at least a portion of the cost savings to the controlling entity 100. For example, and without limiting the present invention, the controlling entity 100 can be a fiber glass
30 manufacturer that sells a new type of chopped fiber glass strand to an

extruder. The new fiber glass strand has properties that makes it less abrasive in a compounding and extrusion operation than conventional chopped fiber glass strand. As a result, there is less wear on the compounding vessel, mixing blades and extruding equipment, as well as
5 less metal contamination in the compounded material and extruded parts. At least a portion of the cost savings realized by the extruder are allocated to the chopped strand supplier.

The invention has been described with reference to the preferred embodiments. Obvious modifications and alterations will occur to those
10 of ordinary skill in the art upon reading and understanding the preceding detailed description. For example, combinations of the embodiments shown in Figs. 2-4 can be utilized to satisfy requirements of the various participants in the PCB value chain. It is intended that the invention be construed as including all such modifications and alterations insofar as
15 they come within the scope of the appended claims or the equivalents thereof.

WE CLAIM:

1. A method of allocating cost savings in a printed circuit board value chain comprising the steps of:

- 5 (a) having a controlling entity;
- (b) causing a laminate incorporating a fiber glass yarn to be delivered to an entity that causes manufacture of a printed circuit board (PCB);
- (c) causing the manufacture of PCBs; and
- 10 (d) allocating at least a portion of cost savings realized from the manufacture of the PCBs to the controlling entity.

2. The method as set forth in claim 1 wherein the causing step (b) is controlled by the controlling entity.

15

3. The method as set forth in claim 1 further including the step of determining cost savings realized from the manufacturer of PCBs utilizing the laminate in step (b) versus utilizing laminate different from the laminate of step (b).

20

4. The method as set forth in claim 1 further including the step of allocating at least a portion of the cost savings to an entity in the printed circuit board value chain other than the controlling entity.

25 5. A method of allocating cost savings in a printed circuit board value chain comprising the steps of:

- (a) having a controlling entity;
- (b) causing a laminate incorporating a fiber glass yarn to be delivered to an entity that causes manufacture of a printed
- 30 circuit board (PCB);

- (c) causing the manufacture of PCBs in a manner that results in a cost savings; and
- (d) allocating at least a portion of the cost savings realized from the manufacture of the PCBs to the controlling entity.

5

6. A method of allocating cost savings in a printed circuit board value chain comprising the steps of:

- (a) having a controlling entity;
- (b) causing a fiber glass yarn in a predetermined form to be delivered to a printed circuit board (PCB) manufacturer;
- 10 (c) the PCB manufacturer causing the fiber glass yarn to be incorporated into a laminate;
- (d) the PCB manufacturer causing manufacture of PCBs; and
- 15 (e) allocating at least a portion of cost savings realized from the manufacture of PCBs to the controlling entity.

7. The method as set forth in claim 6 further including the step of determining cost savings realized from the manufacture of PCBs
20 utilizing the laminate of step (c) versus utilizing laminate incorporating fiber glass yarn different from the fiber glass yarn of step (b).

8. A method of allocating cost savings in a printed circuit board value chain comprising the steps of:

- 25 (a) having a controlling entity;
- (b) causing a fiber glass yarn in a predetermined form to be delivered to a printed circuit board (PCB) manufacturer;
- (c) the PCB manufacturer causing the fiber glass yarn to be incorporated into a laminate;

(d) the PCB manufacturer causing manufacture of PCBs in a manner that results in a cost savings; and

(e) allocating at least a portion of cost savings realized from the manufacture of PCBs to the controlling entity.

5

9. A method of allocating cost savings in a printed circuit board value chain comprising the steps of:

(a) having a controlling entity;

(b) causing fiber glass yarn to be manufactured;

10 (c) causing the fiber glass yarn to be woven into fabric;

(d) causing the fabric to be incorporated into a laminate;

(e) causing the laminate to be delivered to an entity that causes the manufacture of printed circuit boards (PCB);

(f) causing manufacture of PCBs; and

15 (g) allocating at least a portion of cost savings realized from the manufacture of PCBs to the controlling entity.

10 10. The method as set forth in claim 9 wherein at least one of steps (b), (c), (d) and (e) are controlled by the controlling entity.

20

11. The method as set forth in claim 9 wherein steps (b), (c), (d) and (e) are controlled by the controlling entity.

25 12. The method as set forth in claim 9 wherein at least one of steps (b), (c), (d) and (e) are controlled by the PCB manufacturer.

13. The method as set forth in claim 9 wherein the controlling entity is different from the entity causing manufacture of PCBs.

14. The method as set forth in claim 9 further including the step of determining cost savings realized from the manufacture of PCBs utilizing the laminate in step (d) versus utilizing laminate formed from fiber glass yarn different from the fiber glass yarn of step (b).

5

15. A method of allocating cost savings in a printed circuit board value chain comprising the steps of:

- (a) having a controlling entity;
- (b) causing fiber glass yarn to be manufactured;
- 10 (c) causing the fiber glass yarn to be woven into fabric;
- (d) causing the fabric to be incorporated into a laminate;
- (e) causing the laminate to be delivered to an entity that causes the manufacture of printed circuit boards (PCB);
- (f) causing manufacture of PCBs in a manner that results
- 15 in a cost savings; and
- (g) allocating at least a portion of cost savings realized from the manufacture of PCBs to the controlling entity.

16. A method of allocating cost savings in a printed circuit board value chain that includes a yarn manufacturer which manufactures fiber glass yarn, a weaver which forms the fiber glass yarn into a fabric, a laminator which forms the fabric into laminate and a printed circuit board (PCB) manufacturer which forms the laminate into a printed circuit board, which the PCB manufacturer sells to an OEM customer, the method

25 comprising the steps of:

- (a) having a controlling entity;
- (b) transferring to the controlling entity at least partial control of fiber glass yarn manufactured by a yarn manufacturer;
- (c) causing the fiber glass yarn to be delivered to a
- 30 weaver for weaving into fabric;

- (d) transferring to the controlling entity at least partial control of fabric formed by the weaver;
- (e) causing the fabric to be delivered to a laminator for laminating;
- 5 (f) transferring to the controlling entity at least partial control of laminate formed by the laminator;
- (g) selling the laminate to a PCB manufacturer at a market price for other laminate formed from other fiber glass yarn;
- (h) causing the laminate to be delivered to the PCB
10 manufacturer;
- (i) determining cost savings realized by the PCB manufacturer in response to forming PCBs utilizing the laminate versus utilizing the other laminate formed from the other fiber glass yarn; and
- 15 (j) allocating at least a portion of the cost savings to the controlling entity.

17. The method as set forth in claim 16 wherein steps (c), (e), (g) and (h) are initiated by the controlling entity.

20

18. The method as set forth in claim 16 wherein transferring at least partial control in steps (b), (d) and (f) includes transferring ownership and/or releasing a lien.

25

19. The method as set forth in claim 18 wherein:

the controlling entity purchases the fiber glass yarn from the yarn manufacturer;

the controlling entity retains ownership of the fiber glass yarn formed into fabric and formed into laminate; and

ownership of the fiber glass yarn transfers from the controlling entity to the PCB manufacturer when the PCB manufacturer purchases the laminate from the controlling entity.

- 5 20. The method as set forth in claim 19 wherein:
 the controlling entity causes the weaver to be paid for
 forming the fiber glass yarn into fabric; and
 the controlling entity causes the laminator to be paid for
 forming the fabric into laminate.

10

21. The method as set forth in claim 20 wherein the controlling
entity pays or causes the fiber glass yarn manufacturer to pay the weaver
and/or the laminator.

- 15 22. The method as set forth in claim 16 wherein step (i) includes
the steps of:

 forming a first plurality of PCBs utilizing the laminate;
 forming a second plurality of PCBs utilizing the other
 laminate;

- 20 determining cost savings from forming the first plurality of
PCBs utilizing the laminate versus forming the second plurality of
PCBs utilizing the other laminate; and
 applying the determined cost savings to third and subsequent
pluralities of PCBs formed utilizing the laminate.

25

23. The methods as set forth in claim 16 further including the
step of allocating at least a portion of the cost savings to at least one of
the fiber glass manufacturer, the weaver, and the laminator.

24. A method of new product cost recovery in the production and distribution of fiber glass yarn formed into printed circuit boards (PCBs), the method comprising the steps of:

- 5 (a) transferring at least partial control of fiber glass yarn from a first, fiber glass yarn-producing entity to a second, controlling entity;
- (b) transferring possession of the fiber glass yarn to a third, fabric-producing entity at the direction of the second, controlling entity;
- 10 (c) forming the fiber glass yarn into a fabric;
- (d) transferring possession of the fabric from the third entity to a fourth, laminate-producing entity at the direction of the second, controlling entity;
- (e) forming the fabric into a laminate;
- 15 (f) transferring possession of the laminate from the fourth entity to a fifth, PCB-producing entity at the direction of the second, controlling entity;
- (g) forming the laminate into PCBs;
- (h) determining cost savings realized by the fifth entity in response to forming the PCBs utilizing the laminate versus utilizing another laminate formed from another fiber glass yarn; and
- 20 (i) allocating the cost savings to the second, controlling entity.

- 25 25. The method as set forth in claim 24 wherein transferring at least partial control in step (a) includes transferring ownership of the fiber glass yarn to the second, controlling entity.

26. The method as set forth in claim 25 wherein transferring at least partial control in step (a) further includes transferring possession of the fiber glass yarn to the second, controlling entity.

5 27. The method as set forth in claim 25 wherein:
 the second, controlling entity retains ownership of the fiber
 glass yarn formed into fabric by the third entity;
 the second, controlling entity retains ownership of the fiber
 glass yarn formed into laminate by the fourth entity; and
10 step (f) further includes the step of transferring ownership of
 the fiber glass yarn to the fifth entity.

 28. The method as set forth in claim 25 wherein:
 the second, controlling entity pays the third entity for
15 forming the fiber glass yarn into a fabric; and
 the second, controlling entity pays the fourth entity for
 forming the fabric into a laminate.

 29. The method as set forth in claim 25 wherein:
20 the first entity pays the third entity for forming the fiber glass
 yarn into a fabric at the direction of the second, controlling entity;
 and
 the first entity pays the fourth entity for forming the fabric
 into a laminate at the direction of the second, controlling entity.

25 30. The method as set forth in claim 24 wherein step (h) includes
 determining cost savings realized from at least one of:
 extending drill-bit life;
 increasing laminate stack-up height;
30 reducing laminate waste;

reducing laminate utilization due to increased density of component mounting;

reducing migration of metal adhered on the laminate versus laminate formed from the other fiber glass yarn;

5 improving through-hole positioning tolerance; and
improving PCB manufacturing productivity.

31. The method as set forth in claim 24 wherein:

the third entity increases the value of the fiber glass yarn by
10 forming the fiber glass yarn into fabric; and

the fourth entity increases the value of the fiber glass yarn
by forming the fabric into laminate.

32. The method as set forth in claim 24 further including the
15 step of allocating at least a portion of the cost savings to an entity in the
printed circuit board value chain other than the controlling entity.

33. A method of allocating cost savings extracted by a
downstream entity in a value-added processing chain with an upstream
20 entity in the processing chain cost savings, the method comprising the
steps of:

(a) producing a material in a first form;

(b) supplying the material in the first form from a first
entity to a second entity;

25 (c) processing the material from the first form into a
second form having greater commercial value than the first form;

(d) supplying the material in the second form to a third
entity;

(e) processing the material from the second form into a
30 third form having greater commercial value than the second form;

(f) quantifying cost savings realized by the third entity in response to processing the material from the second form into the third form versus the third entity processing another material from the second form into the third form;

5 (g) extracting the cost savings; and

(h) allocating at least a portion of the extracted cost savings to the first entity.

34. The method as set forth in claim 33 wherein step (d) includes
10 the step of supplying the material in the second form from the second entity to the third entity.

35. The method as set forth in claim 33 wherein:
step (c) includes the steps of:

15 processing the material from the first form into an intermediate form having greater commercial value than the first form;

supplying the material in the intermediate form from the second entity to an intermediate entity;

20 processing the material from the intermediate form into the second form having greater commercial value than the intermediate form; and

step (d) includes the step of:

25 supplying the material in the second form from the intermediate entity to the third entity.

36. The method as set forth in claim 35 wherein:

the first entity owns the material until the material in the second form is supplied to the third entity that purchases the
30 material in the second form from the first entity;

the first entity pays the intermediate entity for processing the material into the intermediate form; and

the first entity pays the second entity for processing the material into the second form.

5

37. The method as set forth in claim 33 wherein the first entity receives the material in the first form from a producer of the material.

38. The method as set forth in claim 33 further including the
10 step of allocating at least a portion of the cost savings to an entity in the printed circuit board value chain other than the controlling entity.

39. A computer-implemented method for allocating cost savings associated with a manufacturing process, comprising:

15 (a) realizing a cost savings associated with using a process for manufacturing a product from a starting component associated with a source as compared with using the process for manufacturing the product from a different starting component; and

(b) allocating at least a portion of the cost savings to the
20 source.

40. The method as set forth in claim 39 wherein the process of manufacturing a product is a process for manufacturing printed circuit boards.

25

41. A computer-implemented method for allocating cost savings associated with a manufacturing process, comprising:

(a) monitoring a process for manufacturing a product from a starting component associated with a source and generating cost
30 data associated with the process;

(b) comparing the generated data with stored data reflecting a cost of manufacturing the product from a starting component that is different from the starting component used in the monitored process; and

5 (c) allocating at least a portion of a cost savings associated with the monitored process based on the comparison to the source.

42. The method as set forth in claim 41 wherein the process of
10 manufacturing a product is a process for manufacturing printed circuit boards.

43. A computer-implemented method for allocating cost savings associated with a manufacturing process, comprising:

15 (a) monitoring a process for manufacturing a product from a starting component associated with a source and generating cost data associated with the process;

(b) realizing a cost savings associated with employing the monitored process as compared with another process for
20 manufacturing the product from a starting component that is different from the starting component used in the monitored process; and

(c) allocating at least a portion of a cost savings to the source.

25

44. The method as set forth in claim 43 wherein the process of manufacturing a product is a process for manufacturing printed circuit boards.

45. A computer-implemented method for determining cost savings associated with a manufacturing process, comprising:

5 (a) receiving data reflecting a first process of manufacturing a product from a starting component associated with a source;

(b) comparing the received data reflecting with stored data reflecting at least one other process of manufacturing the product from a starting component that is different from the starting component used to manufacture the product of the first process; and
10

allocating at least a portion of a cost savings associated with using the first process based on the comparison to the source.

46. The method as set forth in claim 45 wherein the process of
15 manufacturing a product is a process for manufacturing printed circuit boards.