The Challenges of Obtaining a Competitive Advantage for Processed Material Suppliers: A Conceptual Study

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Processed raw materials suppliers face challenges to improve their razor thin margins and survive in a market place, where their buyers are pushing them to the edge by placing constant cost reduction demands and threats of replacement with substitution products. Using the steel, aluminum, and composite material industries as examples, this paper integrates the mental models of Quality Functional Deployment, Industry Five Forces, and Resource Based View to analyze these three processed materials and provide implications for such suppliers.

INTRODUCTION

As global competitive pressures continue, manufacturers deploy different resources to play each other in the competitive arena. These resources may be tangible (e.g., machines, technology, materials, and processes) or intangible such as Total Quality Management (e.g., knowledge management/human capital, leadership, customer focus, employee focus, service quality). However, as firms focus their attention on intangible resources, they should not ignore the tangible ones, especially for manufacturers that constantly seek ways of shaving costs and obtaining superior material performance to resolve their needs (e.g., Hshu, Chen, and Jen, 2008). Nowhere is this heat felt more than in the procurement area, which is a manufacturer's major resource cost and needs to be closely monitored to meet its needs.

Procurement analysts have noted that an important factor to ward off competition is the proper selection of processed materials (e.g., steel, Aluminum, and composite materials) since the majority of the cost savings and rectifiable errors are made in the early stages of a product's manufacturing process. Snippets such as GM has found ways to replace Aluminum and steel with Magnesium and has also created innovative welding technology that will increase Aluminum usage corroborate this statement (Detroit Free Press, 2012). Thus processed materials suppliers need to find new ways of overcoming the uncertainty factors affecting production and consumption functions of such tangible resources. These factors include logistics and risk management, availability of the processed materials, pricing, and exchange rates. Consequently, in such markets, the buyers of processed materials are constantly in search for substitute materials since they want to maximize control of their supply side while going into negotiations with their next set of buyers in the supply chain.

Along the same school of thought, exchange theory analysts note that buyers (e.g., procurement managers, R&D specialists of processed materials) face cognitive dissonance and other transaction cost inefficiencies of long-term contracts with suppliers while operating in such uncertain procurement markets and need flexible strategies to optimize supply chain performance. For buyers, this dissonance surfaces in the form of whether or not they obtained the correct price for the duration of the contract and hedged their bets moving forward, considering that equally good processed materials may be available globally. Will competitors outsmart them during the course of these buyers' contract obligation? Based on the procurement literature, material substitution is a major flexible strategy in being market-oriented, curtailing price wars, and offsetting uncertainty factors.

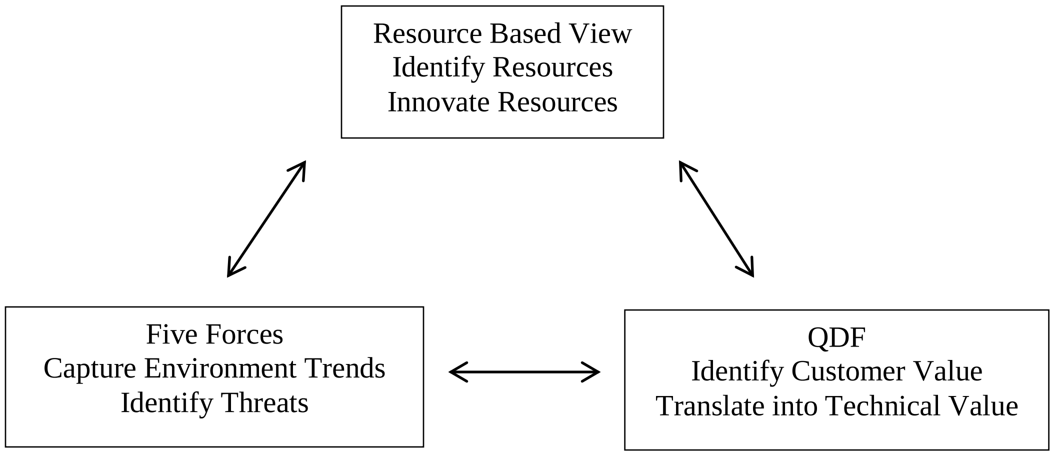
As buyers constantly seek ways to substitute processed materials, the burden rests on their suppliers to revisit their competitive and customer market-oriented models and find ways to remain competent (e.g., Kohli and Jawrowski 1990). Despite such warnings limited research studies are available on how such suppliers may retain their competitive advantage. In the procurement area, quality and customer satisfaction are two important time-based competitive drivers, and studies are incomplete without incorporating the attributes of these drivers. The purchasing literature is also replete with opinions of how managing ones supply base begins with the raw material and is the starting point of quality assurance programs. Quality and customer satisfaction are always paramount to supply chain success in terms of time-based competition, market expansion, and cost savings (Carter and Narasimhan, 1994). Developing and implementing a conceptual model for processed materials suppliers will lower these suppliers' switching costs, given their already razor thin margins and reduce their buyers' material substitution behavior. The outcome of such approaches will not only improve on-going exchange relationships but also help suppliers obtain a sustainable competitive advantage.

The more commonly used mental model to explain such competitive phenomenon is Porter's (1980) Five Forces, which may be used to analyze the industry structure (e.g. competitive intelligence) affecting the processed material suppliers. This model, however, is incomplete in addressing buyer-seller exchange costs since it is external focused. Therefore, researchers have suggested augmenting this model with complimentary internal-focused mental models in order to productively study the supply and demand of such processed raw materials. For example, Molina, Pino, and Rodriguez (2004) argue that the Resource Based View (RBV) should be combined with Porter's Model because it ties the organization's internal resources to strategic decisions. Suppliers may implement this suggestion by producing their processed material capably to suit the contextual situations required by buyers.

Closely tied and related to RBV is the Total Quality Management perspective since competition is incomplete without understanding how organizations improve quality in meeting customer needs (Idris, 2011; Chin and Sofian 2011). Within the Total Quality Management domain, Quality Functional Deployment (QFD) is a viable quality management tool to understand procurement since it is buyer-focused. QFD transforms the buyer's needs and wants into technical properties required for the different stages of a product's developmental process. In addition, QFD is employee-focused since it utilizes a cross functional approach to problem solving (Cauchick-Miguel, 2005). By capturing and disseminating information using cross functional approaches a supplier may complete the cycle of being market-orientated (Kohli and Jawrowski, 1990).

The aim of this paper is to contribute to an organization's knowledge by analyzing the attributes of QFD, Five Forces, and RBV models as applicable to the properties of processed materials. How the three mental models may add value to a supplier's strategic decisions will be an additional competitive resource for them. By integrating the QFD, Five Forces, and RBV mental models (Figure 1) we address how a supplier of processed material may become value-orientated through customer and competitor orientation. After utilizing these three approaches, these suppliers may more productively apply one or more of the generic strategies such as cost, differentiation, and focus to improve the competitive edge of their processed materials.

FIGURE 1
MENTAL MODEL



Since these three mental models are interdependent, there is no precise starting point. In this paper we commence with the QFD approach because it translates buyers' needs into technical properties required from processed materials and reminds suppliers to be market oriented. Porter's Five Forces compliments the QFD approach by providing guidelines on how a supplier may conduct an environmental analysis to infer the impact on its industry and formulate its defensive and offensive strategy, accordingly. The RBV approach assists in the selection and capable use of processed materials, keeping customers' needs in mind. The paper unfolds as follows: Initially, a brief discussion of three processed materials, steel, Aluminum, and composites ensues. These three materials were selected for this study because they are close substitutes for each other, used for diverse industry applications, and users of these materials are consistently seeking innovative ways of sustaining a competitive edge. Next, we discuss each model, namely, QFD, Porter's Five Forces, and RBV and how they may be integrated into a conceptual framework for processed materials. Finally, we propose ways these suppliers may apply the information obtained from this conceptual model.

PROCESSED MATERIALS

Steel and aluminum have been the choice of processed materials for several industrial applications for centuries. Composite materials, such as fiberglass, are considered newer materials and are becoming popular in many industries. It shares the common material science properties such as tensile strength, etc., with steel and Aluminum. Therefore, the consumption of composite material has been gradually increasing over the years. We focus on these processed material suppliers because they function in heterogeneous, dynamic, and diverse markets (e.g., Aerospace Manufacturing, 2010; Akoijam, 2012), and may benefit from RBV, five forces and QFD mental models. The major reasons for their inclusion are:

- They are consumed in diverse industries such as transportation (autos, air, railroad, trucks, pipeline, and ocean vessels), construction equipment, and several consumer goods (e.g. appliances).
- They are considered commodities and have managerial control (cost and risk/return) implications.
- Any product differentiation is short-lived, and material science properties of these materials need continuous improvement to match the dynamic shifts in their consumption patterns.
- To be fruitful, they need the economies of scale in all areas of production and consumption and require to be manufactured with consistent quality.
- They have been used as substitutes for each other in diverse industries.
- They have a direct bearing on the economy of several countries (e.g., Grunert et al., 2005).

Steel

Steel is an alloy that is produced by combining iron ore with low percentages of carbon and other metals such as manganese, nickel, chromium, tungsten, depending on the properties required. Its consumption in manufacturing process outdates Aluminum and composite materials. However, the supply and demand of steel in the United States has undergone dynamic changes over the decades. Since 1950s the high demand for steel encouraged suppliers to ignore potential competition as a few enjoyed the benefits of being the only providers. Following the Product Life Cycle principle such markets evolved and stabilized over time. Supplier clout gave way to buyer dominance as buyers searched for ways to improve material science properties, reduce costs, and improve bargaining abilities over suppliers (e.g., Stubben, 2012).

The main material science properties of steel are its high tensile strength, which results in safer structures, less maintenance, and slower aging of structure. Its properties include high electric and thermal conductivities, low corrosion, easy to fabricate, and moderate life cycle cost. All of these benefits still make steel the major processed material in many industry applications.

Aluminum

Aluminum is extracted from the compound bauxite, which is the most abundant raw material. Its final form is light and durable. It may be combined with small portions of other elements (not necessarily similar to steel) such as zinc, magnesium, copper, etc., to produce different forms of alloys. Aluminum excels in properties such as low density and corrosion resistance properties. Aluminum offers many benefits to manufacturers and designers, including high tensile strength, less comparable weight, high electric and thermal conductivity, and is easy to fabricate and repair. On the downside, Aluminum is more expensive to a manufacturer (tooling cost) than steel. It, however, has a low product life cycle cost because of its low weight and long lasting life, which translates into low fuel consumption and cost to the final user (Kelkar, Roth, and Clark, 2001). Thus cost drivers that are considered a hindrance to the suppliers are considered a benefit to the final user. The consumption for Aluminum has been growing over the decade at the expense of price competition from suppliers, which benefits the buyers. The different cost structures and ownership costs at the supplier and buyer levels indicate that Aluminum can replace steel as a prime material but can also be being replaced by other materials (Berezowsky, 2011).

Composite Material

Composite material is made by combining two or more complimentary materials to achieve better material properties than the material it is trying to substitute. One portion of the composite material serves as a “matrix,” and the other acts as reinforcement in the form of fibers embedded in the matrix. Matrix materials can be epoxy, bismaleimide, or polyimide, to name a few. The reinforcing materials can be glass fiber, boron fiber, carbon fiber, or other more exotic mixtures. Although there are a variety of composite materials, the focus of this study is on composites (e.g., fiberglass, natural fiber composites, and carbon fiber) that are being used as substitutes for Aluminum and steel. The advantages of these composite materials are that they offer similar or better properties in the areas of high tensile strength with less corresponding weight, corrosion-resistance, and biodegradability. In addition, foreign competition is limited due to the high ratio of composite material’s shipping cost as a percentage of its value. Lastly, the buy to fly ratio (ratio of the weight of purchased to finished material for aircraft production) is low as compared to the substitute metals. However, the wasted material is not easily recyclable unlike other metals, which is a disadvantage. A second disadvantage of composite materials is the difficulty to inspect flaws once the product is manufactured. A third disadvantage is that it is difficult to repair portions of its piece (e.g., for dents) once manufactured, and the entire piece needs to be replaced. In addition, composite materials are relatively new and need more testing to establish their long-term performance. Furthermore, they absorb moisture when cured and are expensive to manufacturer (labor intensive and complex manufacturing process). Despites disadvantages, its superior advantage of tensile strength for its weight provides a serious challenge to Aluminum and steel.

METHODOLOGY

ABI database and web-based research was conducted to gather trade and research articles pertaining to the material science properties required from consumers of processed steel, aluminum, and composite materials. In addition, customer behavior information from internal company websites (airlines and automobiles) was obtained. Additional literature was selected if they discussed one or more of the models (Five Forces, RBV, and QFD) with respective to tangible resources. In addition, an article was selected if it addressed:

- the advantages and disadvantages of these materials
- the needs and wants covered by these materials
- the technical difficulties in production and ease of replaceability
- the competitiveness of these materials
- the demand and supply of these materials
- the environmental issues (heterogeneity, diversity, dynamism) affecting the usage of such materials
- the constructs of one or more of the mental models discussed in this study

QUALITY FUNCTIONAL DEPLOYMENT

The QFD and market-orientation literature are closely in terms of the need for an organization to gather and disseminate information pertaining to customer needs. The house of quality is the design tool for QFD that provides a conceptual map for fulfilling the QFD methodology by utilizing a cross functional planning and communication approach (Hauser and Clausing, 1988). For example, using this approach the suppliers' marketing and R&D personnel would be jointly involved in analyzing customer, competitor, and inter-functional organizational information to enhance the corresponding technical properties of their processed materials.

QFD Analysis

The items listed in the first column of Table 1 are the processed material attributes (customer needs and benefits). Based on the literature review (e.g., Bader, 2001; stronwell.com, 2012; Read 1995) and the authors' judgment, the attributes desired from the processed materials discussed in this study are high strength, corrosion-resistance, durability, light-weight, good conductor of heat and electricity, availability, and reasonable cost. These material science properties are essential when buyers of processed materials produce a new design. The technical design parameters that correspond with these attributes (2nd, 3rd, and 4th columns) may be summarized as follows:

- Types of Raw Material Used: Various raw materials are combined to produce the processed material that contributes to the final material science characteristics such as tensile strength, durability, etc.
- Weight of Raw Materials: The amount of each raw material used to form the processed material also determines some of the characteristics of the final product.
- Types of Alloy: Steel, aluminum, and composite materials are graded and contain industrial standardized codes for differentiation purposes. These grades are based on the different features and quality of the processed materials. Grading is important since several basic metals may be used in formation of processed materials. Grading becomes necessary to identify the levels of impurities of the basic metals extracted from earth's crust and local government regulations among other things.
- Density: This is a function of how closely the ingredients are packed in the final processed material (e.g. powdered or crystallized form), which affects the processed material's strength and durability.

These technical design parameters will have a moderate to strong correlation between themselves (Appendix B) since these parameters are an integral form of the final processed material. Each cell of Table 1 represents the degree of correlation between the customer requirements (needs) and the technical design parameters to resolve these needs. High correlation means a superior match. The goal of using QFD is to have an excellent match between all the material science attributes and the summation of the technical design parameters. An ideal balance would be if one technical parameter (e.g., type of raw materials used) could provide a perfect fit for all the material science attributes desired by the customer.

TABLE 1
CORRELATION BETWEEN CUSTOMER REQUIREMENTS AND TECHNICAL DESIGN PARAMETERS

Δ = Strong Correlation ○ = Some Correlation	Raw Material used			Weight of Raw Materials			Types of Alloy/grade			Density		
	Steel	Al	Composite	Steel	Al	Composite	Steel	Al	Composite	Steel	Al	Composite
High Strength	Δ	Δ	Δ		○		Δ	Δ	Δ	○		○
Corrosion Resistant		○	Δ	○			Δ	Δ	○			
Durability	Δ	Δ	Δ		○	○	Δ		○		Δ	Δ
Reasonable Cost	○	○	○	○	○	Δ	Δ	Δ	Δ	○	○	○
Light Weight	○			Δ	Δ	Δ	Δ	Δ	○		Δ	○
Conducts Heat/Electricity		Δ	Δ				Δ	Δ	○	○	Δ	Δ
Availability	○	○					○	○	Δ			

Table 1 should be read as follows: the type of raw materials used in the composite material may resolve the high strength, corrosion resistant, durability, and conductor of heat and electricity attributes desired by the customer (strong correlation). However, this technical parameter does not properly address the light-weight, reasonable cost, and availability needs. In order to cover the entire list of attributes, the composite suppliers will need to introduce other technical parameters into their composite materials. Through the weight of raw materials these suppliers may fulfill the light-weight and reasonable cost requirements. In addition, the type of alloy/grade may resolve the availability issue. The four technical design parameters of composites cover all the attributes listed in the Table 1. For steel, the type of alloy has a strong correlation with all attributes except availability and type of raw material used resolves the availability issue. For aluminum, the type of alloy addresses the requirements of six of the eight attributes, and density correlates with three attributes.

PORTER'S FIVE FORCES MODEL

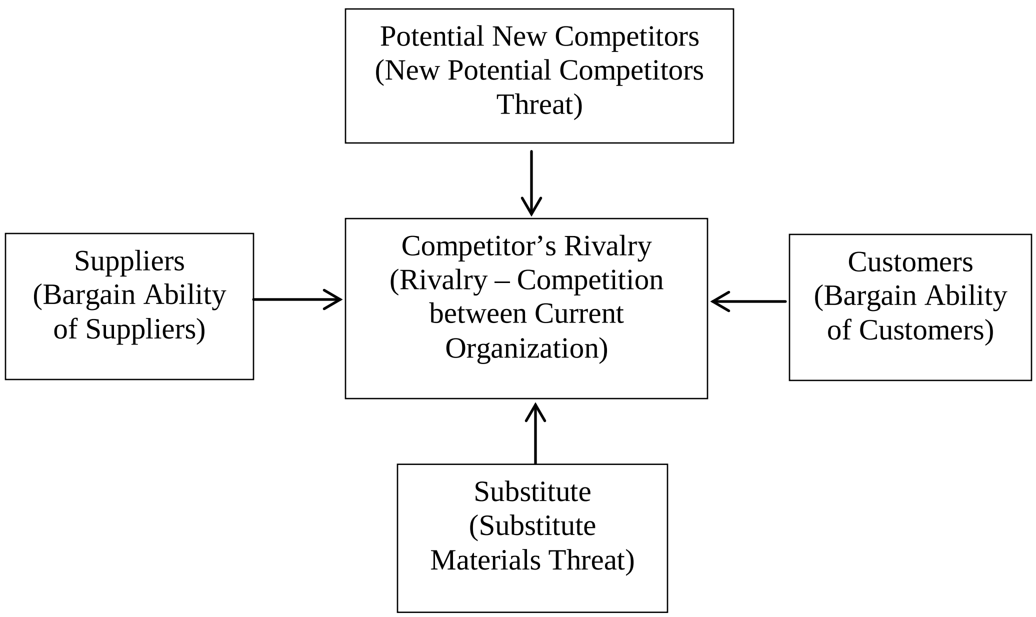
Porter's (1980) five forces describe factors that shape an industry (Figure 2). These factors are as follows:

- the competitive rivalry within the industry under consideration

- the threats of new entrants
- the threats from substitute products
- the bargaining power of the buyers
- the bargaining power of the supplier

Furthermore, several business competitive concepts such as economies of scale, capital requirements, marketing mix, cost advantage (e.g., location, switching, and leverage), exit barriers (e.g., specialized assets), degree of competition (e.g., number of competing firms), buyer dominance, and supplier dominance are analyzed using the five forces. Based on the analysis one may determine the degree of opportunity and/or threat facing a firm operating within the industry under consideration. In summary, the firm conducts a situational analysis using competitive intelligence and extrapolates the information to provide a strategic direction for the firm.

FIGURE 2
PORTER'S MODEL



Steel and Aluminum Industry

From a strategic perspective, the aluminum industry traces the footsteps of the steel industry in the five forces area (e.g., Ungureanu, Das, and Jawahir, 2007; equitymaster.com. 2009). Thus the steel and aluminum industry are discussed together.

Bargaining Power of Buyers

- Due to the increased competition in the steel and aluminum industry, the buyers' power has risen over the years.
- Purchase price as a percentage of buyer's cost is high.
- Buyers are few, concentrated, purchase in large quantities, and have the power to drive prices downwards.
- Buyers are as knowledgeable as the suppliers. Some buyers have also backward integrated to learn the business before spinning it off.

- Switching cost is low for steel buyers since they buy in large quantities and can work the economies of scale in their favor.
- Supplier's product differentiation is a short-term solution since it may be imitated unless patented.
- Large-scale buyers conduct their own R&D in developing and using these materials.

Bargaining Power of Suppliers

- There are only a limited number of major suppliers of raw materials.
- The basic raw materials (iron ore or bauxite) are available in abundance although scattered throughout the world. Steel suppliers may have a disadvantage in this area because of one its main ingredients, coking coal, is in short supply and gives the raw material supplier an upper hand.
- Most of the raw materials for aluminum and steel are imported from other countries.
- Although there are a few global large raw material suppliers, they cannot create high switching costs for the aluminum and steel mills.
- The probability of forward integration by raw materials suppliers is minimal because of the knowledge and technical competencies needed in the buyers' line of business.

Threats of New Entrants

- The threat of new entrants in the steel and aluminum industries is low because of high transaction cost (e.g., assets, first mover's advantage, location, experience curve, access to raw materials, logistics).
- Although the basic raw materials are readily available, entrants need pre-conceived economies of scale model, high capital investments, and finances to endure the long time periods needed to break-even.
- Processed materials suppliers operating within these industries need to achieve economies of scale in all functional areas such as manufacturing, purchasing, R&D, marketing (e.g., price, distribution, sales force, and service network).
- As stated previously, there is a lack of product differentiation in this industry.
- Exit barrier is high since entrants need specialized assets and ability to overcome the high transaction cost in conducting business, whose value is essentially lost if they make an exit.

Internal Rivalry

- The degree of internal rivalry in the steel and Aluminum industries is intense.
- There are a few major players.
- The demand curve for steel and aluminum is elastic.
- Price wars are common.
- There is little room for product differentiation other than through different grades of raw materials, the type of alloy, the percentage weight of each raw material, the density of raw material, and the finished grade of material.
- All marketing tactics may be imitated over time.
- Joint ventures within and across their supply chains may help suppliers in the steel and aluminum industries achieve economies of scale.

Substitution

Suppliers are creating new alloys to overcome the material property weaknesses of Aluminum and steel. Buyers, on the other hand, are interplaying with their organization's fixed and variable cost behaviors to resolve their downstream buyers' needs. For example in the dealings with small orders, organizations may create a variable cost business model; for large orders, a fixed cost model approach may be utilized. Newer materials such as composites are gaining acceptance as suppliers are seeking new ways (e.g., competitive cost behaviors) to obtain a piece of this high demand market.

Composite Materials

Bargaining Power of Buyers

- Composite materials are increasingly being tailored for new uses and have myriad buyers unlike steel and aluminum. Because of their diversity in use no one buyer can influence the price of composite materials.
- Being relatively new and the ability for suppliers to find new uses creates inconsistent demand and supply that dynamically affects the price of composite materials. Therefore, buyers need to plan their purchases.

Bargaining Power of Suppliers

- The number of raw material suppliers for composite materials has increased over the years, which causes the bargaining power of suppliers to decrease. In other words, no one supplier has the power to influence the pricing of raw materials for manufacturing composites.

Threats of New Entrants

- Threat level is considered medium since high levels of R&D expertise is required to build the different material science properties into these materials.
- Machinery and tooling capital cost are high for entrants.
- The number of new foreign competition from India and China is high for existing composite materials; however, this may be offset by the high shipping cost.

Internal Rivalry

- Because of the high R&D expenses, expertise, and patent laws very few firms can mimic the process.
- Products may easily be differentiated and improved, which may curtail price wars but increase competition.
- Demand is expected to increase in the near future, which may cause rivalry among existing firms in this industry to decrease.

Substitution

Composite materials are considered a new technology in the market place, need lengthy government approval time, and do not have the historical performance measures such as data for safety and durability. Thus manufacturers need to closely monitor the material’s adoption and diffusion cycle. The current substitution threat may be mediocre.

Summary from Porter’s Model

Based on the current trends, composite materials are gaining wide acceptance in industrial markets and gradually replacing steel and aluminum by matching or providing enhanced material science properties that are better addressing the diverse market needs. They are better able to compete on differentiation strategies than the other two by being newer in the market, finding new users, and can be manufactured near the customer’s facilities; however, the product life cycle cost in use is high because composite materials need special gadgets for regular safety failure inspection and repair. The steel and aluminum suppliers may need to be innovative as they struggle with their defensive strategies to compete with composite materials. These suppliers may need to study the customer market closely, identify patterns for short term gains, and find competitive methods to prolong their innovations.

RESOURCE BASED VIEW

While selecting a processed material, suppliers need to study its suitability for local market conditions and sustainability issues in addition to its metallurgical properties (keymetals.com, 2011). The Resource Based View (RBV) may be a valuable framework for material selection. RBV proponents treat an organization as a bundle of resources (Fig 3). The more such resources are valuable, rare, immobile, and non-substitutable the more the firm's strategic competitive advantage. These resource categories include assets, capabilities, knowledge, and organization processes that give an organization an identity in the market place (Barney, 1991). They are further classified into physical, human, and organization capital resources. Physical capital consists of technology, plant, location, and material and an organization's control over them. Human capital includes the knowledge, training, experience, and skills of the employees. Organization capital encompasses the internal organizational management structure and process. RBV proponents assert that an organization creates a sustainable competitive advantage by using their resources capably. These resources are the organization's fundamental core competencies for formulating strategies, building relationships, and obtaining superior performance. Adewole (2005) suggests that the type of resources an organization focuses on should be contextual. For example, the author found the competent use of information technology resource to be valuable within the clothing industry in sustaining a competitive advantage.

FIGURE 3
RESOURCE-BASED VIEW

Resource Categories	→	Areas	→	Competitive Advantage Degree
• Physical • Human • Organization		• Assets • Capabilities • Knowledge • Process		• Valuable • Rare • Immobile • Non-substitutable

Suppliers can maintain their market power through a continuous stream of innovations that attenuate the forces of competition. In the processed material industry, innovations cannot be copied easily because of the patent laws and costs. Through innovation these suppliers may gain a temporary quasi-monopoly position that enables them to extract rent from their buyers. On the down side, however, competitors can erode these above-normal rents through substitution materials (Rubera, Gaia, and Kirca, 2012). Therefore, suppliers need to consistently seek ways of possessing value-oriented capabilities and focus on creating value-oriented outcomes (Beverland, 2012).

Since processed material is an important competitive resource, suppliers need to investigate how their competitors and buyers are formulating strategies by using the capabilities of such materials. From a time-based competition perspective, these suppliers should continuously innovative to maximize the possibility that their processed materials are rare, valuable, non-imitable, and non-substitutable at any given point in time. In addition, suppliers need to constantly study ways of enhancing and sustaining the properties of their processed materials along with finding new ways of using complimentary materials to form alloys. The RBV framework not only guides suppliers in the selection of a material but also on how to improve market penetration and product development strategies by capably using their physical, human, and organization capital. For example, does the processed material supplier have the necessary R&D and /or marketing capability to enhance its material properties to build and sustain its customers? Does the supplier have the logistics capabilities to be effective and efficient during the delivery and storage of such materials?

In the case of steel, Table 1, the type of alloy/grade has a strong correlation with all the material science needs of the customer except for availability. Thus the RBV proponents would suggest using this alloy/grade technical design parameter (material's capability) to create a competitive advantage for steel suppliers. In addition, other organizational resources such as inventory management techniques and marketing capabilities (e.g., relational exchange) may add value to the processed material for steel. For aluminum, the suppliers R& D department has room to play its density card against steel. Although aluminum's production cost is high, it translates into a low operating product life cycle cost for the buyer. Thus aluminum suppliers' marketing department may need to use their customer service capability when implementing long-term exchanges with their buyers. In the case of composite material the raw material has a high variable production cost and wastage. Although these composite suppliers may use the advantages of operating in a variable cost industry, the goal should be to reduce wastage and cost.

DISCUSSION

The purpose of the paper is to address the frustrations faced by processed materials suppliers because their margins are being controlled by their buyers. These buyers are trying to reduce their purchasing cost through substitute materials. What may these suppliers do to curtail their razor thin margins and productively utilize the capabilities of their processed materials along with their other organizational capabilities to maintain a competitive edge in the market place?

Although in low-tech industries (e.g. processed materials) innovation is slow, these suppliers can sustain their innovation for longer periods of time than suppliers operating in high-tech industries, where innovation is short-lived (Rubera and Kirca, 2012). On the down side, although the innovation may not be imitated (e.g., patent laws) it may be substituted through other innovative processed materials. Thus the goal of such suppliers should be to squeeze the last drop from their innovative by deploying defensive and offensive strategies using other organizational resources and capabilities.

In this study we suggest that by using QFD, Porter's Five Forces, and RBV, processed suppliers may accomplish their goal of continuously maintaining their competitive edge. In Appendix A, we have summarized the key competitive issues facing three processed materials suppliers: steel, aluminum, and composites. Competitive methods such as innovation, service, leverage, and channel selection identified by Porter (1980) and tested by Dess and Davis (1984) is used in strategy formulation. From a material standpoint, it seems differentiation strategy through technical design parameters such as the type of raw material and/or the grade of the material is the best way of competing. However processed material suppliers are faced with intense competition from within the industry and substitution from without the industry. Thus, other organizational capabilities such as marketing and supply chain may be used to reduce uncertainties and enhance the relational side of the business. Furthermore, R&D and product engineering capabilities may enhance product quality and assist suppliers in achieving a competitive advantage. These activities may be accomplished through strong inter-functional coordination between R&D and marketing (Porter, 1980).

Steel suppliers, for example, may use the weight advantage of steel to focus on customers that need the stability from their compact-sized products such cars. These suppliers' marketing department may need to develop a key account executive team in collaboration with logistics and manufacturing specialists to ensure the availability of this material. Emergency procurement may be systematically introduced into the system to hedge against uncertainties. Marketing and R&D specialists may jointly monitor QFD charts pertaining to their customers and design superior alloys or raw materials. Aluminum suppliers may follow almost similar strategies except that they may focus on their material density as a differentiating tool and the buyers' total cost ownership efficiencies.

Although composite material suppliers have more power than their buyers (being a relative new area), no one supplier is powerful in all the types of composite materials. These suppliers need strong engineering and sales teams to guarantee and increase buyers' faith in their materials against fatigue and failure. They may also need a strong dealer network that can provide complimentary composite materials to any one buyer (consolidation principle). By using the services of distributors they can use customer service, price bundling, and the variable cost nature of their industry to their advantage.

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APPENDIX A
KEY COMPETITIVE ISSUES

	Steel	Al	Composite
Porter's Model	Buyer has power High internal rivalry High substitution threat Power for Coking Coal suppliers	Buyer has power High internal rivalry High substitution threat	Composite supplier maintains power
Processed Material Properties	Slower aging; easy of fabrication and molding to different shapes	Low cost of basic raw materials; more expensive to manufacturer; can be molded to various shapes; ease of fabrication and repair; low operating product life cycle cost to the buyer	Difficult to repair and identify structure flaws; fly to buy ratio is high
QFD	Type of Alloy/grade Type of raw materials used	Type of alloy/grade Density	Type of material used Type of Grade/Alloy
RBV	Need to sustain innovation to recover cost High leveraged industry Need other capable resources to sustain the material competency	Need to sustain innovation to recover cost High leveraged industry Need other capable resources to sustain the material competency	High VC industry; Material competence still the primary focus
Strategy	Innovation life should be prolonged until another innovation is in the horizon Develop and maintain relational exchange and efficient customer service with key accounts Made to Stock practices to match the Economies of scale needed Maintain high inventory levels to serve key accounts Manage inventory risk by tying it with distribution strategy to explore small and diverse markets (e.g. geographic dispersed; minor modification to product) Explore needs where processed material weight is to be confined in a small space (e.g. compact cars)	Innovation life should be prolonged until another innovation is in the horizon Develop and maintain relational exchange and efficient customer service with key accounts Made to Stock practices to match the Economies of scale needed Maintain high inventory levels to serve key accounts Manage inventory risk by tying it with distribution strategy to explore small and diverse markets (e.g. geographic dispersed; minor modification to product) Use product density as a differentiation strategy to prolong product life.	Improve production operation efficiencies to reduce Fly to Buy Ratio Sell in industries where processed material uncertainties (demand fluctuations) is high Practice niche marketing strategy; market specialty products Market to geo-segments where raw material availability for manufacturing steel or aluminum is problematic

APPENDIX B
TYPE OF RAW MATERIAL AND WEIGHT OF THE RAW MATERIAL

Correlation: Very Strong
Reason: Part of the weight of the processed material depends on the type of raw materials used. For example, steel is made from iron ore, coking coal, and lime stone. Although the basic raw materials contribute to the total weight of steel, during the production process, the basic raw materials undergo thermodynamic property changes and may individually loose or gain weight.

Type of raw material and types of alloy

Correlation: Strong
Reason: Although the type of raw materials and alloy are related, the percentages of the raw material that constitute the alloy can be different.

Type of raw material and density

Correlation: Very Strong
Reason: The final processed material depends on the raw materials used to manufacture it. However, it is important to understand how well these raw materials are packed to create the differences in final form of the product (e.g., crystalized versus powered form). Although strongly correlated, processed materials that use the same raw materials may have different densities.

Weight of raw material and types of alloy

Correlation: Weak
Reason: Different raw materials may have identical weight, but the final alloy is dependent on the type of raw material used to produce it. However, two similar alloys must have identical weights of the different raw materials used to produce it. In this instance, there is a very strong correlation.

Weight of raw material and density

Correlation: Moderate
Reason: Just as density is strongly correlated to the type of raw material, it is also correlated to the weight of raw materials. In general, heavier materials have higher density values than lighter ones. Thus, these two characteristics are moderately correlated. However, density affects the space occupied by the material. For example, a ton of iron ore and ton of charcoal may have the same weight but will occupy different amount of space.

Types of alloy and density

Correlation: Very Strong
Reason: As discussed above, different types of alloy have different density. Density of an alloy changes when additional elements of the periodic table are added to the manufacturing process. In addition, similar types of alloy may have different technical properties and different density because of the metallurgical process undertaken during production (e.g. annealing, case hardening, and depth of case hardening).