

# A Survey-Based Vision For Restructuring The Concrete Business In New Residential Communities In Egypt

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**Abstract:** Due to its evolving technology and dynamic nature, a sizeable segment of the world's construction market that used to partly rely on traditional site-mixed concrete (SMC) had almost completely shifted to ready-mixed concrete (RMC) several decades ago in the developed countries. Likewise, this targeted trend has been observed in developing countries. The Egyptian residential sector has also adopted some corrective changes in this direction in the last decade. Nevertheless, the vast majority of builders in the Egyptian market have continued to oppose to this global paradigm shift. The observed "cultural" resistance to change seems to be chiefly driven by the difference in the unit price of SMC and RMC, overlooking the latter's superior characteristics and its added values that fundamentally outweigh this apparent difference in cost. This survey-based study aims at promoting the use of RMC over SMC for construction of new residential communities in Egypt. A mixed (qualitative and quantitative) approach was used in this survey. A customized survey, comprised of a series of interviews with consultants/contractors in the field and a detailed questionnaire targeting practitioners, was conducted to gauge market responsiveness to the desired change. The targeted market shift towards RMC hinges on generic variables: price, concrete quality and customer satisfaction, and market-specific variables: local concrete culture, perception of average customers, and permitting process.

The survey revealed that professional participants, a small fraction of the local concrete market, are aware of the added values of utilizing RMC. The participation rate is clearly indicative of the absence of awareness of the numerous competitive advantages of using RMC in the Egyptian market. The resistance to change, unarguably, still hinges on the mistakenly believed difference in SMC and RMC unit prices, not the cost/benefit ratio.

**Keywords:** *Ready-Mixed Concrete, Site-Mixed Concrete, Survey, Quantitative And Qualitative Approach*

## 1. Introduction

Modern concrete, typically a mixture of cement, coarse and fine aggregates and water (Neville, 1995), is a durable construction material that exhibits decent fire-resistance and reasonable water-tightness and requires very little maintenance (Mehta and Monteiro, 2006). Concrete is the only major building product arriving at the job site in a plastic state, which allows unprecedented construction versatility.

The idea of ready-mixed concrete (RMC) was first introduced in 1903 by Jurgen Heinrich Magens, a German architect. In 1907, he discovered that the available time for transportation could be prolonged not only by cooling fresh concrete but also by vibrating it during transportation. The increasing availability of special transport vehicles, supplied by the new and fast-growing automobile industry, played a positive role in the development of the RMC industry. The short history of the RMC industry has been dominated by the need to produce and economically deliver a high quality product. RMC has numerous advantages over site-mixed concrete (SMC); the following underscores the chief characteristics of RMC (Varghese and Pillai, 2007):

- Fast production and easy transportation
- Fully controlled manufacturing and quality
- Time saving and reduced wastage of raw material
- Elimination of storage space for raw materials at site
- Elimination of procurement or leasing of plant and machinery

- Minimization of labor associated with production
- Streamlined site organization

On the other hand, RMC is costlier than SMC more due to the transportation cost and inclusion of special admixtures in the RMC price. The price is typically offset by the speed of construction and improved quality that would save on the amount of concrete.

RMC was first introduced to the Egyptian market approximately 35 years ago in Cairo. In 2007, there were 14 large cement production companies (compared to nine in 2000), of which eight companies produced more than 2 million metric tons yearly (Darwish, 2007). With a consumption of about 10% of the local cement production, RMC business in Egypt is still in its infancy (Lafarge, 2009). In comparison, approximately 70% of the cement produced in an industrial country like Japan is used for RMC business. In a developing country like Sri Lanka, (the use of) RMC is mandatory in all multistory buildings. In contrast, the current Egyptian Code of Practice (ECP, 2007) does not enforce or promote the use of RMC in construction. This indicates that the concrete business in Egypt is in a dire need for radical changes and involvement of all pertaining parties in order to meet the international RMC practices and consumption rates. These efforts, in turn, are expected to ameliorate construction quality in Egypt. Embracement and implementation of a modern business vision are evidently easier in more dynamic construction sectors such as the emerging new residential communities.

## 2.RMC Early Beginnings in Other Markets: A Historical Overview

The recent increasing availability of customized transportation vehicles, due to the fast growing automobile industry, played a positive role in the rapid development of the RMC industry. In this section, the highlights of the history of RMC in three different countries located in three different continents are presented. The United States and the United Kingdom, representatives of developed countries, have long embraced private and governmental entities regulating RMC business. On the other hand, India, a developing country, has followed the pioneering steps of countries that have well-established policies regulating the RMC business-related practices and activities.

**The United States** - It was not until the early 20<sup>th</sup> century that the RMC industry took a pronounced turn in the United States. In 1913, the first concrete batch was mixed off site in a central location and then delivered by truck to a construction site in Baltimore just before the First World War. In 1926, the first concept of transit mixer was originated. In 1930, when only a handful of RMC plants were in operation, the National Ready Mixed Concrete Association (NRMCA) was founded to promote the use of RMC throughout the United States. In the 1940s, with the wartime, RMC demand increased dramatically due to the unprecedented booming in construction of industrial and governmental buildings, housing and highways. By the year 1958, there were 3,657 ready-mixed concrete plants in the United States (NRMCA, 1958). A significant growth of RMC business took place between the years of 1950 and 1980. On an average, the RMC industry has supplied 25 million cubic meters per year between the years of 1974 to 1980. By the year 1990, there were 3,700 RMC existing producers. By that time, approximately 75% of the concrete consumed by the construction industry was provided by RMC producers. By 2002, the number of industry plants had increased to 5,570. In 2005, the RMC industry in the United States had over \$27 billion in annual sales and 107,000 employed workers (Syverson, 2008). Over the past 35 years, the RMC industry has been shifting from single-plant firms to multi-plant operation firms. With 11 million tons annual production and 6,000 employees, Titan Cement Group is an example of a worldwide leading RMC multi-plant operation producer ([www.titanamerica.com](http://www.titanamerica.com)).

**The United Kingdom** - In 1931, the first RMC plant in the UK was built in Bedfont, west of London (Cassel, 1986). The capacity of the first batch plant central mixer was 2 cubic yard (approximately 1.5 cubic meters) with an output of 40 cubic yard (approximately 31 cubic meters) per hour (Dewar and Anderson, 1992). In 1933, the first specifications on RMC were published in the UK. At the eruption of World War II in 1939, there were only 6 RMC plants operating in the entire UK, one supplying RMC through agitators from a central mixer and the others were using concrete truck mixers. Since then, the RMC industry tended to outpace the construction needs mainly because the culture of the concrete market was not ready at that time to pay more for an improvement of quality and service. The British Ready Mixed Concrete Association (BRMCA) was established in 1950 by five RMC companies that were each operating a single plant. The main role for BRMCA was to represent the interests of its members in technical, commercial and legal issues. The growth of the RMC industry was significant in the UK between the years of 1950 and 1974 with a peak production of 31 million cubic meters per year. In 1968, the members of BRMCA had 800 RMC plants in operation (Dewar and Anderson, 1992). In 1990, 43% of the total cement consumed in the UK was being used by RMC plants. By the year 2009, the total UK RMC production was approximately 15 million cubic meters (ERMCO, 2010). In addition to BRMCA, The British Aggregate Construction

Materials Industries (BACMI) and the Independent Quality Scheme for Ready Mixed Concrete (QSRMC) help regulate the RMC industry in the UK.

**India** - The idea of RMC was first introduced to India in 1950 during the construction of dams such as Bhakra Nangal, Koyna. The transportation of concrete at the construction site was done either manually or using ropeways and buckets or conveyor systems (Rashid, 2001). The early beginnings of RMC in India was mainly driven by the significant demand from the emergence of the new metropolis cities such as New Delhi, where construction needs and pace could never be met using SMC. In 1991, RMC was established in a plant for the first time in Pune by private companies. In 1993, two more RMC plants were established in Mumbai to commercially sell RMC to specific nearby projects. At the end of year 1994, these two plants were allowed to sell RMC to other projects. Concurrently, RMC producers from outside India became more interested in the Indian market. The growth of RMC has picked up in the last two decades resulting in approximately 3.8 million cubic meters of concrete per year produced by 76 RMC plants in India. These plants were distributed over 17 cities with a total capacity of around 3875 cubic meters per hour. Most of the RMC plants in India are located in 7 major cities, where they contribute 30% to 60% of total concrete used in these cities. In 2002, lead RMC producers in India established the Ready Mixed Concrete Manufacturers Association (RMCMA) for making RMC the preferred building material of choice across the entire country. The organization maintains balance between the interests of RMC producers and the needs of end users, designers, and owners ([www.rmcmaindia.org](http://www.rmcmaindia.org)). Despite these efforts, RMC contributed to only about 5% of the total concrete used in India (Alimchandani, 2007). More recently, and driven by strong recommendations of consulting offices, the use of RMC in modern projects in India has become mandatory. Additionally, due to limited stockpiling and mixing areas and the growing need to control environmental pollution have expedited the use of the RMC in major cities in India. The number of modern RMC plants has, subsequently, continued to grow rapidly in India. This trend is observed despite the additional cost that ranges from 12% to 20% as compared to SMC.

### 3. Insight For Practitioners

Concrete construction is one of the most vibrant sectors of the economy in Egypt. This has materialized in the growing market demand for RMC in the last decade (Darwish, 2007). Nonetheless, construction in the residential sector in Egypt generally still relies on low or mediocre quality concrete – predominantly SMC. Despite the aggressive presence of several giant international RMC manufacturers in the Egyptian market, such as Lafarge, Italcementi and Cemex, their activity prove to be ineffective in pushing SMC out of this market or even minimizing its popularity. It is imperative to note that the use of inadequate concrete quality (SMC) has countless direct and indirect negative impacts on the nation's economy in this sector. Direct impacts include reduced longevity (life cycle) of structures, oversized concrete elements, questionable serviceability and time and expenses associated with site operations. Indirect impacts include waste of the nation's natural resources and numerous environmental hazards.

Looking towards the future of concrete in Egypt, situational analysis (internal and external) of the concrete industry must be strategically studied (David, 2012; Wheelen and Hunger, 2011). The internal component discerns strengths and weaknesses of this industry by studying and analyzing all internal factors affecting its success and development. The external component, which is by challenging default, identifies industry opportunities and threats and includes both task and societal environments. The task environment addresses customer-related needs and satisfaction, while the societal environment observes social, technological, economic, and political aspects of the industry. The popularity of SMC in the Egyptian construction market is observed even in the new residential communities, which are typically inhabited by the middle and upper class population. Good examples of the new residential communities are those being developed in the City of New Cairo. These communities are expected to consume unprecedented volumes of concrete in the history of construction industry in Egypt; a major opportunity for the concrete industry. Conversely, a major threat to this industry is the depletion of its natural resources, e.g. coarse aggregate, and the continuous reliance on imported cement.

Unfortunately, well-documented literature addressing quality and consumption of concrete in the Egyptian market is very scarce and generally incomprehensive. Hence, in order to portray a realistic picture of the concrete business in Egypt the authors' relied heavily on their experience with the local construction market as well as the informative interviews conducted with selected experts in the field – as will be discussed. Conversely, the literature for modern concrete markets such as that of the United States has been long well established and documented in countless references and standards (e.g. ACI, 2012; ASTM, 2012; and AASHTO, 2012). Supported by the authors' professional experience and undeniable market observations, Table 1 compares the prime characteristics of concrete business in Egypt against those of a typical healthy market.

Table 1: Concrete Business in Egypt Versus Typical Universal Market

Aspect	Egypt	Typical Universal Market
<i>Raw Materials</i>	Not well selected	According to standards
<i>Typical Design Strength</i>	Generally low	High
<i>Predominant Concrete Type</i>	SMC	RMC
<i>Workmanship / Quality Control</i>	Low to Medium	High
<i>Consumer Awareness</i>	Limited	High
<i>Professional Engineering Licensing</i>	Not required	Must
<i>Proper Construction Practices and Supervision</i>	Not enforced	Enforced
<i>Following Building Codes and Specifications</i>	Flawed	Must
<i>Permitting Process</i>	Superficial/non-transparent	Must
<i>Price of High Quality Concrete</i>	Unnecessary burden	Justified and accepted
<i>Non-professional Interferences</i>	Significant	None
<i>Typical Structure Life Cycle</i>	Unknown	50-100 years
<i>Environmental Impact Assessment</i>	Generally never	Considered

#### 4. Business Fundamentals

Concrete is the prime component in construction in Egypt, one of the largest business sectors of the nation’s economy. Introducing modern technologies and alternatives such as RMC to a construction market is challenging by default. RMC presence in the concrete market in Egypt is generally emerging, but still underrepresented due to the stagnant and firmly established existence of a lower-priced substitute, chiefly SMC. The culture and mentality of customers in the concrete market in Egypt has been long resisting the idea of sustaining little extra cost for the superior characteristics and added value of RMC. This idea was cultivated and embraced by biased customer perception, uninformed business decisions, and further supported by a generally flawed/non-transparent permitting process. These factors can be collectively thought of as a threat to promoting RMC use in Egypt. In order to analyze the mechanics of the concrete market in Egypt, it is inevitable to recognize and utilize the underlying business fundamentals of the local market: forces of a competitive market, marketing tools, and customer satisfaction.

Porter’s five forces analysis is a framework for industry analysis and business strategy development (Porter, 1979). These forces that determine the competitive intensity and, therefore, attractiveness of a market are as follows: threat of new entrance, threat of substitute products or services, bargaining power of customers (buyers), bargaining power of suppliers and intensity of competitive rivalry. In this context, the significant and long presence of SMC in the Egyptian market poses a real threat to promoting RMC. This is a major marketing obstacle, particularly when the key players in the market are unaware of the value of this superior and more universally attractive substitute (RMC) and, hence, are resisting change.

Like any other industry, RMC is subject to marketing dynamics. Being a product and service, RMC is governed by four marketing mix tools: product, price, place and promotion (McCarthy and Perreault, 1991). Kotler and Keller (2012), emphasize that price is one of the chief marketing mix tools and the most challenging to control. The complexity of pricing decisions is attributed to the dynamic interaction of several parameters affecting customer satisfaction, a major component in any industry (Kotler and Keller, 2012). The prime satisfaction attribute from the customer’s point of view has different weighting and relevance depending on the customer’s size and situation, and type of project.

In the past, business was product-oriented. In modern holistic markets, however, business became customer-oriented. Historically, quality has spanned over several dated definitions: meeting specifications, meeting customer satisfaction and meeting customer expectations, to “exceeding customer expectations”, the most universally accepted definition. Kano Model (the Voice of the Customer), a popular tool in modern markets, effectively addresses customer satisfaction (Kano et al., 1984). The categories identified by the model are the following: threshold (quality characteristics that must be present), performance (the closer the furnished product/service to meeting the requested needs, the happier the customer is), and excitement (those qualities that the customer was not expecting but received as a bonus). RMC customers’ satisfaction could be adequately gaged by utilizing this model.

Ameliorating marketing of RMC in Egypt would necessitate utilizing the foregoing fundamental business tools. In view of this, it is our opinion that RMC unit price is a “must be” characteristic (threshold) for customers. As such, sacrificing profit by producers is necessary - even for a transitional period of time - in order to convert price into performance (quality).

## 5. Scope

This study aims at modernizing the present state-of-the-practice of the concrete business in the new residential sector in Egypt. The real-estates of these communities should be conserved by maximizing concrete quality to price value. The authors postulate that market shift to RMC is a root solution for restructuring the concrete business in these new communities. In order to achieve this strategic goal, the study proposes key variables that are perceived to control concrete quality and price. These business variables are based on thorough diagnosis of the mechanics of the local concrete market.

## 6. Methodology

Concrete is a highly complex industry that is inevitably governed by several independent business variables. The authors are of the opinion that some of these independent variables are generic and the rest are specifically-related (local) to the Egyptian market. In lieu of this proposed classification, the generic independent variables are the following: price, quality and specifications/standards, and customer satisfaction. The specific variables (pertaining to Egypt) are the market culture and mentality, perception and awareness of average customers/consumers, and permitting process. Promoting market shift towards RMC, the objective of the study, is selected to be the dependent variable in this study. The study hypotheses can be summarized as follows:

- RMC unit price is the prime variable that affects sales volume
- There is a reverse relationship between RMC unit price and its sales volume
- Added value (quality) of RMC has offsets the price difference between RMC and SMC
- Customer satisfaction is directly related to RMC sales volume

A mixed (qualitative and quantitative) approach was used in this study. The qualitative component was based on interviewing ten experts in the engineering consulting and/or construction business in an unstructured manner. The selected experts have unique experience in concrete construction. The quantitative component utilized the results of a questionnaire designed for practitioners. The participants of the questionnaire were selected to be quite diverse: contractors, customers/consumers, and consultants. The questionnaire was disseminated via email or personal communication to 200 practitioners. However, the sample size was 160 responses, out of which only 50 participants claimed to have used or state they are familiar with RMC. The questionnaire designed for this study comprised the following 38 questions:

1. What is your age?
2. What is your gender?
3. What is your occupation (job)?
4. How many structures utilizing RMC are you aware of?
5. How many years have passed since RMC was first introduced to you?
6. How often do you use RMC?
7. What is your impression or experience with RMC?
8. What are the factors that could influence your decision when you select concrete type?
9. What type of concrete members utilizing RMC that you experienced?
10. Did you use a concrete pump?
11. What is the maximum arm length of the pump?
12. What is the typical number of floors of buildings that you supervised?
13. What is typically your targeted mean strength of concrete?
14. What is the typical range of cement content for your project?
15. What was the average concrete volume based on design drawings?
16. What is the typical percentage of the actually casted concrete (w.r.t. BOQ estimates)?
17. What is the average unit price of RMC?
18. What is the typical difference between the unit prices of RMC and SMC?

19. What is the typical payment method?
20. What is the average pouring time?
21. Did you experience any delays in RMC supply?
22. Does RMC achieve your targeted strength?
23. What is the average compressive strength of the tested samples?
24. What is your degree of satisfaction with RMC?
25. Do you find the RMC unit price reasonable?
26. Do you perceive RMC use an added value?
27. Will you use RMC again?
28. Would you recommend RMC?
29. What are the advantages of using RMC?
30. Did you obtain a proper building permit?
31. What is the zone type (as per the building permit) that you typically work in?
32. What is the typical market price for land in the new residential communities?
33. What is the average cost of the concrete structure?
34. What is the average nominal cost of the building facade?
35. What is the average selling price of apartments in the new communities?
36. What is the overall construction time?
37. What is the acceptable difference between RMC and SMC unit price that would motivate you to shift to RMC?
38. If the difference between RMC and SMC total cost does not exceed 2-3% of a residential unit in the new communities, would you fully shift to RMC?

The conducted study examined the impact of price, quality and customer satisfaction (key variables) on the market shift towards RMC use in the residential communities in Egypt. The study also inspected the adversities of the unhealthy market culture, limited awareness of average customers/consumers, and flawed permitting process and their relation with the relatively insignificant presence of the RMC in Egypt. In doing so, the characteristics of the performed analysis are as follows:

- Purpose: validation of hypotheses
- Unit: individual
- Time horizon: cross sectional
- Type of investigation: correlation

In order to assess the benefits and estimate the real cost of using RMC versus SMC, which are instrumental for evaluating the results of the conducted survey, the authors relied on the interviewees' feedback. All unit prices and costs included herewith are those collected at the time of conducting the survey. The average market price of bulk cement (OPC) is 400 EGP/ton.

## 7. Results And Discussion

In this section, the outcome of the unstructured interviews and the highlights of the conducted questionnaire are summarized and discussed. Since most of the customers in the residential sector in Egypt favor SMC, collecting the survey data was extremely challenging. In addition, due to the nature of the one-on-one interview, only ten experts were interviewed. While the sample size of the survey is rather small, the adopted approach was designed around the selectiveness in choosing the interviewees and background diversity in the participants of the questionnaire.

The interviewed experts emphasized that price is probably the major obstacle that faces the widespread adoption of RMC in the Egyptian market. In this regard, the reader is cautioned to differentiate between unit price and total cost. They also indicated that most customers in the Egyptian market mistakenly assume that the unit price is indicative of the total cost. In order to circumvent this "apparent" price difference between RMC and SMC an average customer normally settles for the latter - irrespective of the design and construction ramifications that eventually result in direct savings. The experts also pointed out that the customer's perception and awareness of RMC characteristics, e.g. durability and sustainability, and superior performance are generally rather poor. They underlined that the modest presence of RMC in the construction market can be attributed to three characteristics distinguishing the local market: resistance to change, absence of market motivation, and lack of trust amongst concrete practitioners. For example, in the absence of a trustworthy concrete strength an average structural engineer, who enjoys no power over the owner and the contractor, typically assumes low to medium quality

concrete, which results in oversized structure. A group of the selected experts reluctantly admitted that the permitting process is entirely flawed, non-transparent, and often times involve unprofessional acts. Unsurprisingly, this observation is confirmed in the *Doing Business 2013* annual report prepared by the World Bank (2013). Out of 185 countries, the report ranked Egypt number 165 and 152 in the effectiveness of dealing with construction permits and enforcing contracts, respectively.

While contractors represent more than two-thirds of the sample of the performed survey, the results of the questionnaire were unsurprisingly in line with the experts' feedback. The survey indicated that approximately 90% of the sample has known RMC more for than five years and approximately 70% of the respondents have used RMC on regular basis – more than a few times (Figure 1). As previously pointed out by the experts, approximately three-quarters of the sample perceive price as the governing factor for selecting RMC (Figure 2).

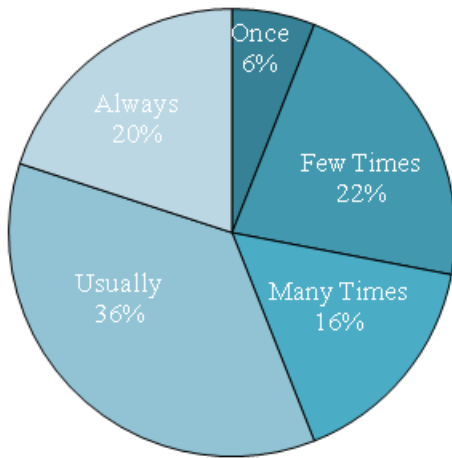


Figure 1: Participants' Usage of RMC

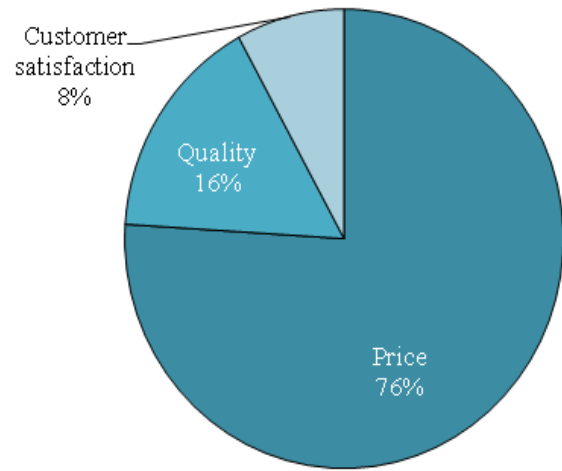


Figure 2: Factors (Variables) Influencing Choosing RMC

The SMC unit price reported by the interviewee ranged from 250-270 EGP/m<sup>3</sup> (approx. 42-45 USD/m<sup>3</sup>); while that of the RMC ranged from 310-340 EGP/m<sup>3</sup> (approx. 52-57 USD/m<sup>3</sup>) – a similar range was reported by about 90% of the participants. These prices yield a difference of about 25% between SMC and RMC, which is somewhat higher than the upper limit recorded in India. About 90% of the participants reported unit price differences of SMC and RMC between 0 and 40% (Figure 3). Approximately more than half of the sample has a typical desired concrete compressive strength of 250 Kg/cm<sup>2</sup> (mediocre quality) and only less than 10% seek a compressive strength of 350 Kg/cm<sup>2</sup> or higher. It should be noted that it is customary, yet a mistaken common practice in the local market, to design residential buildings for an average nominal compressive strength of 250 kg/cm<sup>2</sup>, regardless of concrete type. Accordingly, the structural design does not utilize the additional strength of RMC when used. Customer satisfaction with RMC quality appears to be relatively high upon using it. Approximately, three-quarters of the sample was satisfied with RMC quality to price value (Figure 4). About two-thirds of the sample generally realize the advantages of RMC and perceive this as an added value and the rest are indifferent (Figure 5). As shown in Figure 6, 24% of the participants protested to any increase in concrete unit price. Conversely, the bulk of the sample (40%) appears to tolerate up to 10% increase in the unit price. A smaller group representing 28% of the sample was receptive to an additional cost of 20% to 30% associated with RMC. A much smaller group amounting to 8% of the participants were willing to afford up to 40% increase in the unit price. Unsurprisingly, three-quarters of the participants (approximately the sum of the former three groups of participants) would use RMC unconditionally when they realize that the additional cost does not exceed 2-3% of the average selling price of an apartment in the new communities (Figure 7).

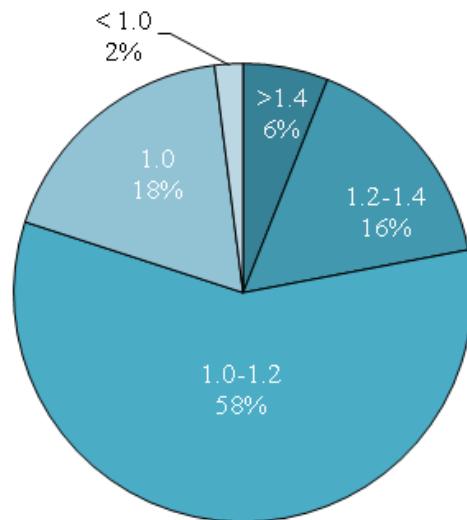


Figure 3: Difference between Unit prices of RMC and SMC (Expressed as a Ratio)

Whilst approximately three-quarters of the participants were satisfied with RMC quality (Figure 4) and two-thirds of them perceived it an added value (Figure 5), their resentment of the associated additional cost was evident (Figure 6). In fact, the satisfying RMC unit price of the majority of the participants is totally unrealistic. This is indicative of their incorrect perception of value engineering. They “culturally” could not realize nor estimate the cost offsets in terms of savings in concrete quantities and superior quality. This stems from their inability to quantify the value of redesigning a concrete structure using a significantly higher strength concrete; RMC. It is the authors’ opinion that their understanding of the relationship between quality and price is flawed. One should be able to relate these outcomes to a more biased pool of polarized anti-RMC users (non-participants), who are not even willing to consider RMC as a viable alternative to SMC. This group of concrete customers, the main stream in the Egyptian concrete market, is suffering from fear of change and unwillingness to embrace the proper definition of quality and price that should rationalize their decision and satisfaction.

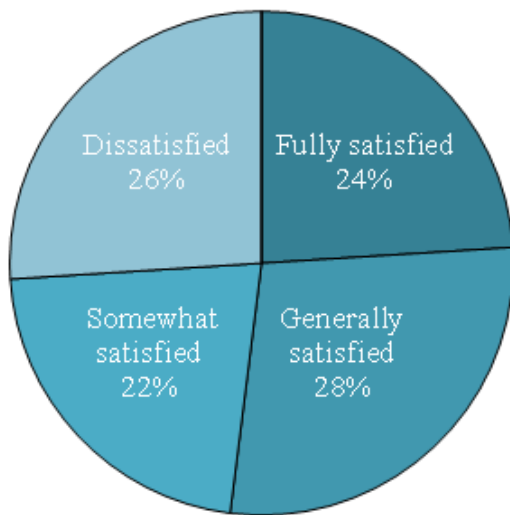


Figure 4: Degree of Satisfaction with RMC Quality to Price Ratio

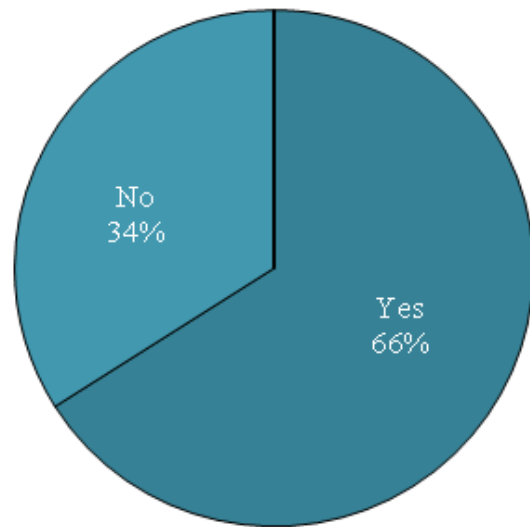


Figure 5: RMC Added Value

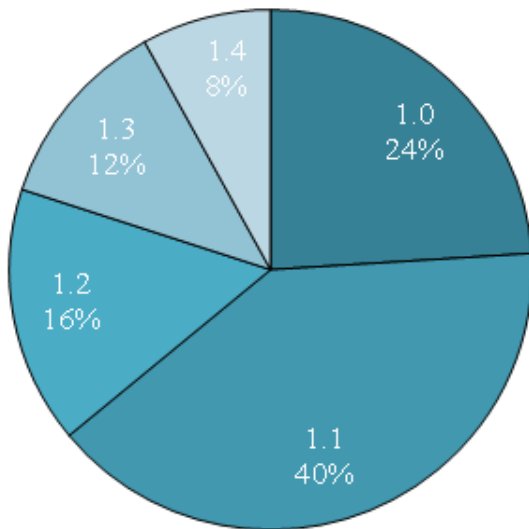


Figure 6: Acceptable Difference Between Unit Prices of RMC and SMC (Expressed as a Ratio) That Would Motivate The Participant To Fully Shift to RMC

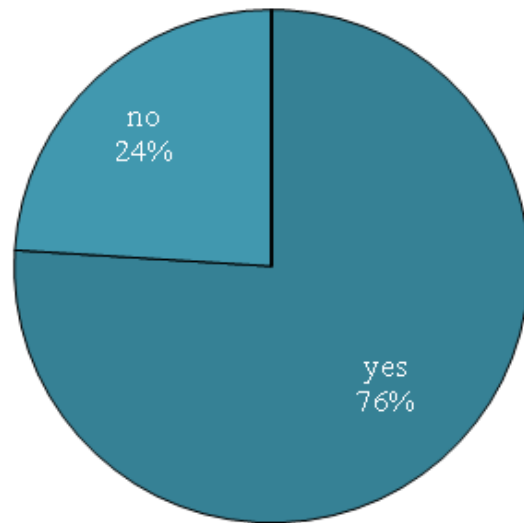


Figure 7: RMC Acceptance Rate - Knowing That the Additional Price of Using RMC Typically Falls within 2-3% of the Average Selling Price of an Apartment in the New Communities.

Further to the foregoing qualitative comparison with the healthy concrete markets, the performed questionnaire (results not presented) has reassessed the raised deficiencies and flawed practices in concreting in the Egyptian market. Unlike healthy concrete markets, where the key construction aspects interact in harmony and fully controlled by a recognized building code and a robust permitting process, the construction industry in Egypt suffers from the weaknesses summarized in Table 1. These deficiencies manifest in the insignificant presence of RMC in the local concrete market and the high degree of mistrust amongst practitioners (developers, designers and contractors). The authors are of the opinion that there is a pressing need to rectify this status quo. Final resolution to this matter is rather challenging; however, it is believed that the practitioners should all be well-versed in the advantages of RMC. This wishful consensus among these parties, obviously, can never replace enforcement of building codes and adequate permitting process.

## 8. Recommendations

Corrective efforts and remedial actions should be initiated by pertinent parties to ameliorate concrete business in Egypt. These measures are imperative on several fronts: educational, professional and organizational. Consultants and construction organizations should collaboratively educate undergraduates and graduate engineering students on the technical and economic benefits of RMC. This can be achieved by approaching academicians for including this in university curricula. Workshops and seminars should be held for designers, contractors and owners to educate them in the area of RMC technology. The publications of these professional conventions should be made available online for free. RMC manufacturers should seek forming a union or association that would protect their interest and promote the use of RMC. The local building codes must emphasize on the use of RMC and retiring SMC. These steps should materialize into making the use of RMC mandatory by local building authorities. This would require closing the gap in the current unit price difference between RMC and SMC through market incentives such as offering tax breaks and bulk cement at preferable prices to RMC companies and subsidizing the price of fuel for their trucks. Re-evaluation of the present permitting process and enforcement of more efficient, transparent and stringent construction regulations are indispensable for this desirable shift to take place. These efforts would, collectively, redirect the concrete industry in Egypt towards RMC. As such, this will profoundly capitalize and allow better management of the emerging investment in the new residential communities. Sustainable aspects of the market shift from SMC to RMC should inevitably be investigated at the local level.

## 9. Conclusions

The dated local concrete business in Egypt is in a dire need for immediate corrective actions. This would require promoting awareness and collaboration amongst concrete consumers and practitioners as regard to the numerous advantages of shifting toward RMC at the expense of SMC. The success of such corrective measures is dependent on embracing new construction regulations that enforce the use of RMC. The shift is instrumental for a healthy concrete market in the new residential communities. This survey-based study was designed to endorse this shift.

The performed survey investigated the relationship between RMC unit price and its sales (presence in the market). It also probed customers' inclination that is controlled by their perception of RMC benefits and satisfaction level. The results of the survey indicate that both real cost and superior characteristics of RMC are not well understood by the majority of the customers; surprisingly even amongst those who use RMC on a regular basis. While the interviewed experts are promoting the use of RMC; the mainstream customers in the Egyptian market are unable or unwilling to realize the benefits and added value of RMC and, therefore, its unquestionable leverage over SMC. Understanding of the underlying facts behind the difference in unit price between SMC and RMC is apparently flawed. Mainstream customers are, generally, pre-occupied by the misconception that RMC is always overpriced. This inappropriate market perception is well-fed by improper local practices including lack of construction supervision, inadequate building code regulations and non-transparent permitting process. These uncertainties and ambiguities have, collectively, established liability concerns among designers and consultants who typically resort to overdesign concrete structures, the main driver of unforeseen construction cost. In such stagnant cultures, it is unlikely that mainstream customers would take the initiative to spend the effort to understand the technicalities and finances of a better concrete alternative; RMC. Unmistakably, adopting RMC as a viable substitute to SMC would improve quality and reduce total construction cost.

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