

# CONSTRUCTION RESEARCH CONGRESS 2014

## *CONSTRUCTION IN A GLOBAL NETWORK*

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PROCEEDINGS OF THE 2014 CONSTRUCTION  
RESEARCH CONGRESS

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May 19–21, 2014  
Atlanta, Georgia, USA

SPONSORED BY  
The Construction Institute of the American Society of Civil Engineers

School of Building Construction  
Georgia Institute of Technology

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# Preface

The Construction Institute (CI) of the American Society of Civil Engineers (ASCE) and the CRC2014 Organizing Committee are pleased to present the Proceedings of the 2014 Construction Research Congress (CRC2014) held on May 19-21, 2014, at Georgia Institute of Technology, Atlanta, Georgia, USA. CRC2014 is proudly hosted by the School of Building Construction at Georgia Institute of Technology.

The theme for this conference is "Construction in a Global Network." It highlights the importance and relevance of construction engineering and management (CEM) research, where schedules and networks are among the most distinguishable subjects, and the impact of globalization continues to transform the industry and the education of students, professionals and researchers alike. The effect of professional and social networks is dramatically changing existing communication patterns and information sharing paradigms in the way we live, practice, conduct research, and educate students in the domain of CEM and beyond. As a reflection of current integrated practice and project delivery, network technology is also allowing a better communication among construction owners, architects, engineers, construction managers, subcontractors, consultants, and facility managers. The School of Building Construction (BC) resides in the College of Architecture at Georgia Tech, which carries a legacy of enormous contributions in the fields of Building Information Modeling (BIM), high performance buildings, and Geographic Information Systems (GIS), among others. In this context, BC lies at the intersection of planning, architecture, engineering, management, and technology, thereby becoming a fertile ground for supporting the goal of CRC: to provide academics and industry professionals a platform to present and discuss research needs and findings that have profound impacts on the future of the architecture-engineering-construction industry. To better understand the goal of CRC, this Preface contains an opening article by Halpin et al. that describes the early days of the Construction Research Council, recognized as the premier forum for CEM research.

The Conference Proceedings contain 242 peer-reviewed papers, which stemmed from 580 abstracts submitted, 501 abstracts accepted, and 301 final papers submitted. In addition to the signature tracks traditionally offered by previous CRCs, this Congress is incorporating new tracks that reflect some of the emerging integrated practices and technologies such as building information modeling, interactive geospatial information systems, integrated facility and program management, sustainability-conscious design, and building performance, for a total of 18 tracks:

- Information Technology, Modeling and Simulation
- Construction Education
- Sustainable Design and Construction
- Productivity and Workforce Issues
- Construction Means and Methods
- Construction Planning and Control
- Risk and Safety Management
- Facility Management and Program Management

- Automation and Data Sensing
- Quantitative Methods
- Infrastructure Management and Disaster Response
- Contracting and Legal Issues
- Cost and Schedule
- Organizational Issues
- Global Construction Issues
- Building Performance and Life Cycle Analysis
- CII Research
- Urban Planning and Geographic Information Systems

On behalf of the Construction Institute of the American Society of Civil Engineers and the CRC2014 Organizing Committee, I extend best wishes to you for a memorable and remarkable occasion.



**Daniel Castro-Lacouture, Ph.D., P.E.**  
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# Introduction

## Early Days of the Construction Research Council

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## ABSTRACT

The Construction Research Council (CRC) has served researchers in Construction Engineering and Management as a major clearing house for about 40 years. The number of members has continued to grow, and is currently over 300 worldwide. However, little historical record exists, and thus there is a need to document the early days of CRC for future generations. In an effort to address this issue and promote future growth, the authors gathered materials from our members and put together a short article. The article describes the early days of CRC. As a concluding remark, the authors recommend that the CRC increase efforts for creating opportunities to engage and advance the industry. This would be in the spirit of CRC's early days.

## CONSTRUCTION RESEARCH COUNCIL

Research in Construction Engineering and Management (CEM) is an essential element of our industry. For almost 40 years, the Construction Research Council (CRC) has been a meeting point and clearing house for interaction and information exchange among CEM researchers pursuing fundamental and applied research in CEM. Particularly, given the early view on construction as a business rather than an

engineering activity, the importance of research can't be underestimated in establishing CEM as an academic discipline (Halpin 2007).

CRC members have contributed to improving the industry through research in diverse CEM fields, such as constructability improvement, estimating methods, project planning and control, building information modeling and visualization, value engineering, innovative materials and means, innovative technologies, automation, project delivery methods, productivity analysis and improvement, risk analysis techniques, safety and health, and labor and organizations, to name a few areas. The members have also helped to disseminate this research through the authorship of textbooks, publications, guidelines, and specifications. They have also contributed to industry training and continuing education, and perhaps most importantly, to the education of our young practitioners through our universities.

CRC is a committee in the Construction Institute's (CI) Education and Research Directorate. The committee is comprised of over 300 academics and practitioners who are dedicated to research in CEM. The objectives of the committee are:

- To be recognized as the premier forum for CEM research.
- To maintain an active membership of qualified construction professionals.
- To advance engineering knowledge and practice by stimulating and encouraging innovative research in the field of CEM.
- To disseminate knowledge by sponsoring activities and assisting members in educational and professional development initiatives.
- To promote the activities of CRC and its individual members that enhance the practice of and research supporting the discipline of CEM.
- To mentor professionals who aspire to be researchers.

## **EARLY DAYS OF THE CONSTRUCTION RESEARCH COUNCIL**

The most pivotal event to re-establish CRC was the 1976 ASCE Spring meeting in San Diego. Meetings to organize CRC occurred in the early 1970's under the leadership of L. R. "Dick" Shaffer, who was, at the time, the Director of the Construction Engineering Research Laboratory of the Army Corps of Engineers in Champaign, IL. CRC existed but did not meet regularly, however, until 1976. At this time, the Nuclear Regulatory Commission (NRC) in Washington D.C. contacted ASCE with the intention of identifying researchers who might assist with research into the construction of nuclear power stations. A group of approximately 12 researchers met at the ASCE Spring conference in San Diego; the meeting was led by the CRC chair at that time, Russel C. Jones. This triggered a visit to Washington, D.C. in the summer of 1976 to meet with representatives from NRC (Halpin 2007).

NRC by this time had changed research direction, dropping the earlier interest in supporting research. Instead, it was recommended that CRC (again led by Russel C. Jones) meet with program managers at the Energy Research and Development Agency (ERDA is now the Department of Energy (DOE)). Research managers at ERDA were receptive to proposals made by CRC. By the Fall of 1976, researchers with connections to CRC had received ERDA-funded projects in the amount of approximately \$1 million. These grants included a workshop at the Pennsylvania State University, a project to study Information Management for Nuclear Power



Stations at the Georgia Institute of Technology, and other projects at The University of Texas at Austin and The Ohio State University. At a time when construction research projects were a rarity and projects in the amount of \$12,000 a year were considered large, this level of funding was unprecedented. At least two of the funded projects were in excess of \$300,000 over a multi-year period. This totally unexpected level of success lifted CRC into orbit, and it has been a cornerstone organization within the construction research community ever since (Halpin 2007).

## **GETTING MOMENTUM WITH INDUSTRY SUPPORT**

The early days of CRC, as with any new group, were somewhat disorganized. The early members were a dozen or so academics and one or two industry members. Some of the early members are: Lance Bell, John Borcharding, Bob Carr, Fattah Chalabi, Marvin Gates, Dan Halpin, Donn Hancher, Vir Handa, Bob Harris, Bill Ibbs, Russel Jones, Bill Ledbetter, Ray Levitt, George Mason, Saxon Palmeter, Boyd Paulson, Randolph Thomas, and Richard Tucker

Along with the ERDA projects that boosted construction research, the other major and concurrent activity evolved from the Business Round Table (BRT), in the form of a Construction Industry Cost Effectiveness (CICE) Project, headed by Charles D. Brown, vice-president of DuPont. That project, in its early research stage, was triggered by a dinner in New York City, to which several faculty members from CRC were invited. Some of those faculty members were then included at subsequent meetings of the Construction Committee of the BRT, which funded a few grants for specific studies.

Simultaneously with the BRT and ERDA research activities, a few of the BRT companies decided to hire academics as consultants to help improve their projects. The initial contacts came from the Annual Construction Productivity Conference that evolved from the earlier ERDA project under the leadership of John Borcharding at The University of Texas at Austin. The major companies in that regard were Procter & Gamble, DuPont, Monsanto, and Texaco, along with some companies from the UK. Most of the projects were cost-reimbursable, and the contractors were willing to cooperate with the academic consultants. Several tools—such as Foreman Delay Surveys, Time-Lapse Photography, and Work Sampling—were utilized, and the credibility of the academic involvement was enhanced.

One of the companies, Texaco, invited consultants from The University of Texas at Austin to engage in a large project in Louisiana, and agreed to deviate from the consulting mode with a research grant involving graduate students and faculty. That project was renewed for five years, with regular reports to the Texaco management, and involved both PhD and MS students, some of whom obtained leaves of absence from Texaco to pursue their advanced education on that project.

A similar approach was used with the military services, which had programs of sending promising young officers back to school to obtain Master's degrees. As a result of CRC meetings and communications, some universities proposed having their military students gather data from their military projects for their thesis and dissertation research—another credibility enhancement for academic research.

In the meantime, CRC decided to appoint a committee—including Richard Tucker, Lance Bell, and Bill Ledbetter—to develop recommendations for a CRC

structure and activities. Out of that committee came recommendations for the creation of the R. L. Peurifoy Award, and a program of CRC workshops (e.g., Construction Research Congresses) as well as a restructuring of the journals affiliated with the Construction Division of ASCE (e.g., Journal of Construction Engineering and Management). These complemented the Marvin Gates award for young faculty.

The activities of CRC, the BRT, the consulting activities of faculty on large projects, the multi-year research project between The University of Texas at Austin and Texaco, and the Construction Productivity Conference brought the stars into alignment at a Construction Productivity Improvement (CPI) Conference in 1982. (Significantly, only industry representatives were allowed to make presentations at the CPI Conference, offering their experiences.) One of the speakers at the Conference, from Texaco, stated that academic research had benefitted Texaco significantly in time and money savings on the Louisiana project. The speaker invited other companies to join with Texaco in pooling resources for academic research. That resulted in many brainstorming meetings involving representatives of industry and the Business Roundtable that culminated in the establishment of the Construction Industry Institute (CII) in October of 1983.

CII was carefully constructed to be a cooperative venture between academia and industry. Although it was to be headquartered at the University of Texas at Austin, it was structured to involve faculty and graduate students at many other universities, and to be a national organization. The ideas for its establishment were endorsed at a meeting of CRC, and the first CII Director who was, coincidentally, the Chair of CRC (Richard Tucker) selected the faculty members on the first CII Research Teams. The industry representatives were grateful, since they were not well acquainted with the construction faculty. There have now been many hundreds of faculty members and graduate students from most CRC universities that have participated in CII projects. CII has an Academic Committee that has the specific mission to include more faculty members in its research activities. Over the past 40 years, many industry-academic cooperative endeavors have evolved at other institutions.

Several other parallel activities also evolved from CRC. The increasing stature of CRC led to strong support from the National Science Foundation – the premier research agency of the federal government – leading to numerous grants to CEM researchers at major universities throughout the U.S. As part of its research oversight, CRC has recommended that ASCE Publication Standards incorporate actual data to improve their credibility with the industry. CRC has been a focal point for the evolution of academic/industry research over the years, including other regions of the world, such as Europe, the Middle East, South America, Australia, Japan, Korea, and China. ASCE has held at least two conferences in Saudi Arabia and Bahrain that involved representatives from CRC and comparable organizations in other countries.

## **CONCLUDING REMARKS**

Although it is often overlooked, research is essential for the future of our industry!! As the challenges in CEM become larger and more complex, the need for research becomes more critical. A review of the early days of CRC offers a very

important lesson for the industry in general. Earlier efforts by the CRC were closely tied with the industry's needs and this led to great mutual successes. Recent CRC activities have been a bit disjointed and drifted away from application within the industry.

As a first step to reestablish CRC's relationship with the industry, the 2014 Construction Research Congress will host an ASCE Construction Institute (CI) board of governors meeting. This will provide a great opportunity to discuss how CRC members can conduct joint activities with the industry to improve its practice through research and dissemination activities. Such initiatives of this type should be continued to insure the success of CEM as an academic discipline as well as a profession.

This article is only a small recollection of CRC's past. Efforts to document our past activities—like important milestones in the past 40 years—need to be continued. The authors hope that CRC members continue to work on such documentation, and thus can archive important milestones in CRC history. More histories and events related to CEM in general can be found in Halpin's article in JCEM (Halpin 2007).

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## **Contributions of Construction Project Team to Cost Overruns: The Contractors' Perspective**

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### **ABSTRACT**

A project is adjudged successful if it is completed to time, within the budgeted cost and meets client's expectation. However, there is the global issue of construction cost and time overruns, which has contributed to poor project performance. Contractors have always been seen as the culprit in this regard, whereas, the contractor is not solely involved in construction projects, there are other project team members who determine the path of the project success. This study assesses the causes of cost overruns, viewing this from the contractor's assessment of the contribution of its project team members. The study was conducted using questionnaire surveys in which 100 questionnaires were distributed to contractors using purposive sampling; data were analyzed by the use of descriptive statistics. The results show that lack of adequate pre-contract planning and project team co-ordination are the most significant factor among construction professionals leading to cost overruns. The study made recommendations which are of good benefit to the client, project team members and contractors.

### **INTRODUCTION**

Cost is a major consideration throughout the project management life cycle and can be regarded as one of the most important parameters of a project and the driving force of project success. It is the universal and most highly visible performance metric for indicating project success. As such, Tichacek (2006) enjoined project managers and project controls professionals to expend their effort and intelligence to properly manage cost. However, cost overrun is a general occurrence in the global construction industry (Rahman, Memon, Abdul-Azis & Abdullah, 2013). Chimwaso (2000) opined that projects completed within budget are rarely found compared with cases of projects with cost overrun. The ripple of this phenomenon is usually friction between clients (especially government clients), project managers and contractors on the issue of project cost variation (Creedy, 2005). Cost overrun is a very frequent phenomenon and is almost associated with nearly all projects in the construction industry.

This trend is more severe in developing countries where these overruns sometimes exceed 100% of the anticipated cost of the project (Azhar, Farooqui and Ahmed (2008). Findings on construction projects in some developing countries revealed that the actual cost of construction do exceed the original contract price by about 30% (Al-Momani, 1996). It was further observed that both public sector and private sector projects have similar pattern of cost overruns. Endut, Akintoye and Kelly (2009) in a study conducted on 308 public projects and 51 private projects in

Malaysia observed that 46.8% and 37.2% of public sector and private sector projects respectively are reported to be completed within the budget. Further result of the study show that 84.3% of the private sector projects were completed within the 10% cost deviation compared with 76.0% of the public sector projects. This is an indication that both private sector and public sector driven projects are susceptible to cost overruns.

Against this backdrop, with the dearth in financial resources available for infrastructure development most especially in developing countries and the susceptibility of construction projects to cost and time overruns, it is necessary to improve construction efficiency by means of cost-effectiveness and timeliness; this would certainly contribute to cost savings. However, the responsibility for project performance is often placed on the contractor, whereas the contractor is not solely and absolutely involved in project execution. The contractor is always at the receiving end of project delays which in most cases leads to cost overruns. Previous researches have identified the contractor as a major contributor to project delays and cost overruns in the areas of financial difficulties, equipment and tool shortages, material shortages, poor site management practices, construction mistakes and defective works; this is shown in table 1.

**Table 1. Studies on Causes of Delays by Contractors**

S/N	Causes of Delays by contractors	References
1	Contractor financial difficulties	Aftab, Abdul Rahman and Ade Asmi (2011); Sambasivan and Yau (2007); Assaf and Al-Hejji (2006); Arshi and Sameh (2000), Frimpong, Oluwoye and Crawford. (2003); Al-Khalil and Al-Ghafly (1999), Majid and McCaffer (1998), Mansfield, Ugwu and Doran. (1994); Arditi, Akan and Gurdamar (1985)
2	Equipment and tool shortages	Wendle (2008)
3	Materials shortage	Sambasivan and Yau (2007); Ruiz-Torres and Farzad (2006); Arditi et al. (1985)
4	Poor site management	Sweis et al. (2008); Aibinu and Odenyika (2006); Arshi and Sameh (2006); Faridi and El-Sayegh (2006); Ahmed et al. (2003); Augustine and Mangwat (2001); Arditi et al. (1985)

## RESEARCH METHOD

A quantitative approach using structured questionnaire was used to elicit information from contractors on their perception of project consultants' contribution to cost overrun. The population of the study is professionals in the contracting organisations within Lagos state, Nigeria. The data gathering procedure was by administering the questionnaires to the respondents who were contractors in

construction firms. 100 questionnaires were administered all along for the study of which 57 were returned and used for the analyses.

## RESEARCH FINDINGS

### Causes of Cost Overrun

Table 2 shows a list of factors responsible for cost overrun of building projects with their corresponding mean scores. It is seen that lack of planning and coordination had the highest mean item score of 4.09 and the least being long period between time of bidding/tendering and award having a mean score of 2.98. Others are additional costs due to variation works/change order, changes in plans and drawings or design changes, increase in the cost of construction materials, poor cost control method, inconsistent client brief, changes to specification, fluctuations in the cost of labour and/or material, inexperienced contractor, lack of control on excessive change orders, inaccurate quantity estimate or excess quantity during construction, inadequate site investigation, delayed payments to contractors, wrong method of cost estimation, lack of coordination between design team and general contractor, complexity of construction projects, poor communication among contractor, consultant and the client, lowest bidding procurement method, acceleration required by the owner (Shortening of contract time) and long period between time of bidding/tendering and award with their respective mean scores to be 3.96, 3.93, 3.74, 3.70, 3.70, 3.69, 3.61, 3.60, 3.58, 3.54, 3.36, 3.30, 3.29, 3.26, 3.25, 3.23, 3.07, 3.05 and 2.98.

**Table 2. Factors Responsible for the Cost Overrun of Building Projects**

<b>FACTORS</b>	<b>N</b>	<b>Mean</b>	<b>Ranking Index</b>
Lack of planning and coordination	55	4.09	1
Additional costs due to variation works/Change order	57	3.96	2
Changes in plans and drawings or Design changes	56	3.93	3
Increase in the cost of construction materials	57	3.74	4
Poor cost control method	57	3.70	5
Inconsistent client brief	56	3.70	5
Changes to specification	54	3.69	7
Fluctuations in the cost of labour and/or material	56	3.61	8
Inexperienced contractor	55	3.60	9
Lack of control on excessive change orders	57	3.58	10
Inaccurate quantity estimate or excess quantity during construction	57	3.54	11
Inadequate site investigation	56	3.36	12
Delayed payments to contractors	57	3.30	13
Wrong method of cost estimation	56	3.29	14
Lack of coordination between design team and general contractor	57	3.26	15
Complexity of construction projects	55	3.25	16

Poor communication among contractor, consultant and the client	57	3.23	17
Lowest bidding procurement method	57	3.07	18
Acceleration required by the owner (Shortening of contract time)	57	3.05	19
Long period between time of bidding/tendering and award	57	2.98	20

### Clients Contributions to Cost Overrun

From Table 3, it can be seen that the actions of client that mostly contribute to cost overrun is lack of planning and coordination with a mean score of 4.77. Thereafter are additional costs due to variation works/change order having a mean score of 3.86, inadequate financial provision had 3.80, inadequate brief to the design team had 3.63, changes in plans and drawings or design changes had 3.58, method of procurement employed had 3.51, different consultant for design, supervision and contract administration had 3.47, delay in making decisions had 3.47, poor communication among contractor, consultant and the client had 3.37, executive bureaucracy in the client's organisation had 3.35 and supplementary/additional agreement had 3.21.

**Table 3. Clients Contributions to Cost Overrun**

FACTORS	N	Mean	Ranking Index
Lack of planning and coordination	57	4.77	1
Additional costs due to variation works/Change order	57	3.86	2
Inadequate financial provision	56	3.80	3
Inadequate brief to the design team	57	3.63	4
Changes in plans and drawings or Design changes	53	3.58	5
Method of procurement employed	57	3.51	6
Different consultant for Design, Supervision and Contract Administration	57	3.47	7
Delay in making decisions	56	3.41	8
Poor communication among contractor, consultant and the client	57	3.37	9
Executive bureaucracy in the Client's organization	55	3.35	10
Supplementary/Additional agreement	57	3.21	11

### Consultants Contributions to Cost Overrun

Table 4 gives a list of factors responsible for causing cost overrun of building projects. From the Table, it is seen that lack of planning and coordination had a mean score of 4.00, changes in plans and drawings had 3.95, insufficient geotechnical investigation had 3.89, additional costs due to variation works had 3.88, lack of control on excessive change orders had 3.76, cost under estimation had 3.75, working out unrealistic programme of work had 3.70, inaccurate quantity estimate or excess quantity during construction had 3.68, changes to specification had 3.61, poor communication among contractor, consultant and the client had 3.59, faulty and



incomplete information at the inception stage had 3.55, complexity of construction projects had 3.44, suspension of work ordered by the engineer had 3.42 and different consultant for design, supervision and contract administration had 3.32.

**Table 4. Consultants Contributions to Cost Overruns**

<b>FACTORS</b>	<b>N</b>	<b>Mean</b>	<b>Ranking Index</b>
Lack of planning and coordination	57	4.00	1
Changes in plans and drawings	56	3.95	2
Insufficient geotechnical investigation	57	3.89	3
Additional costs due to variation works	56	3.88	4
Lack of control on excessive change orders	54	3.76	5
Cost under estimation	57	3.75	6
Working out unrealistic programme of work	56	3.70	7
Inaccurate quantity estimate or excess quantity during construction	57	3.68	8
Changes to specification	57	3.61	9
Poor communication among contractor, consultant and the client	56	3.59	10
Faulty and incomplete information at the inception stage	56	3.55	11
complexity of construction projects	55	3.44	12
Suspension of work ordered by the Engineer	55	3.42	13
Different consultant for Design, Supervision and Contract Administration	56	3.32	14

#### **Remedies to Cost Overrun**

Table 5 presents the remedies for minimising or preventing cost overrun of building projects. Adequate financial provision had a mean score of 4.52, employing the right procurement method had 4.47, effective and efficient project management had 4.43, provision of comprehensive information had 4.36, good communication among the construction project team had 4.21, thorough estimating process had 4.19, improving contractors' managerial skill had 4.14, control over excessive change order or variation had 4.07, procurement of construction materials and other items in collaboration with the client ahead of time had 4.05 and adequate contingencies allowance had 3.77.

**Table 5. Remedies for Minimising or Preventing Cost Overrun**

<b>Remedies</b>	<b>N</b>	<b>Mean</b>	<b>Ranking Index</b>
Adequate financial provision	56	4.52	1
Employing the right procurement method	57	4.47	2
Effective and efficient project management	56	4.43	3
Provision of comprehensive information	56	4.36	4
Good communication among the construction project team	57	4.21	5
Thorough estimating process	54	4.19	6
Improving contractors' managerial skill	57	4.14	7
Control over excessive change order or variation	56	4.07	8
Procurement of construction materials and other items in collaboration with the client ahead of time	57	4.05	9
Adequate contingencies allowance	57	3.77	10

### **SUMMARY AND DISCUSSION OF FINDINGS**

From the analysis as shown above, lack of planning and coordination is the most significant factor that cause cost overrun of building construction project. In Fetene (2008), this was identified as the second most significant cause of cost overrun. The other four most significant causes of cost overrun as observed in their order of significance are: additional costs due to variation works/change order, changes in plans and drawings or design changes increase in the cost of construction materials and poor cost control method. Elhag and Boussabaine (1999) ranked variation orders and additional works second as most significant cause of cost overrun. Further findings shows that lack of planning and coordination is also the most significant contributory factors by the client that causes cost overrun. The actions of client that often result into cost overrun is their attitude of getting involve in inadequate or poor planning and coordination of the work to be done. This could be as result of the time allowed by the client for contract documentation. It could also be as a result of choosing incompetent consultants and contractor. Other contributions by the client are additional costs due to variation works/change order, inadequate financial provision, inadequate brief to the design team and changes in plans and drawings or design changes are the most five significant factors that result into cost overruns of building construction project.

It is seen that the most significant factor causing cost overrun as a result of consultants contribution is also lack of planning and coordination ranking 1<sup>st</sup> on the list, while changes in plans and drawings, insufficient geotechnical investigation, additional costs due to variation works and lack of control on excessive change orders ranked 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> respectively.

The recommended remedies to minimizing or preventing cost overrun is adequate financial provision which is ranked 1<sup>st</sup> among others and employing the right procurement method, effective and efficient project management, provision of comprehensive information and good communication among the construction project team were ranked 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> respectively.

## CONCLUSIONS

The following conclusions can be reached from the study:

- 1) Lack of planning and coordination is described as the most significant factor causing cost overrun of building construction projects.
- 2) Lack of planning and coordination is described as the most contributory factor by the client causing cost overrun of building construction projects.
- 3) Lack of planning and coordination is described as the most contributory factor by the consultants causing cost overrun of building construction projects.
- 4) The recommended remedies to minimize or prevent cost overrun is adequate financial provision among others.

It can be seen that Lack of planning and coordination or poor planning and inefficient coordination happens to be a general factor causing cost overrun and also a contributory actions from the client and the consultants. This is traceable to the competency of consultants in handling a project and the little involvement of client in a building project.

## RECOMMENDATIONS

This will be targeted towards the project team members who are the client, consultants and the contractors.

### Recommendations to the Clients

- a) Clients should allow adequate time for planning and provide good platform for effective coordination of building projects.
- b) Client should allow sufficient time for proper feasibility studies, planning, design, and information documentation and tender submission. This helps to avoid errors and omissions that consequentially help in avoiding or minimizing cost overrun.
- c) Client should ensure that all briefings and decisions are finalized as to what will be incorporated in the building projects. This is to reduce that amount of additional costs due to variation works.
- d) Client should ensure that a good cost control measures is established before embarking upon a project.
- e) Clients should ensure that adequate funds are available before projects are started, so that contractors can be paid in accordance with the contract agreement and materials can be bought on time to forestall increment in material prices.
- f) The client should endeavor to select a competent consultant and a reliable contractor to carry the work.

### Recommendations to the Consultants

- a) The consultants should be involve in continuous coordination and direct communication, which will eliminate design discrepancies and errors as well as omissions in design and also provide an opportunity for professionals to review the contract documents thoroughly? This help in eliminating change orders or variation works.
- b) Adequate cost advice on incessant changes to plans and drawings requested by the client should be given.

- c) Detailed and comprehensive site investigation should be done at the design phase to avoid variations and late changes during the construction phase.
- d) Adequate control should be exercised on excessive change orders requested by the client.
- e) They should also expedite action on review and approval of design documents, preparation of payment of certificates for contractor orders early enough.
- f) Implement the necessary measures to reduce construction cost, since construction cost reduction is one way of reducing potential cost overrun.

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