

Cost and Time Focused Risk Analysis in the Turkish Construction Industry

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Abstract

This study reveals that the present position of Turkish contractors in terms of the risk management of cost and time overruns in construction projects. To this aim, 68 companies participated in a detailed questionnaire of which data was evaluated by means of the frequency analysis and the relative importance index method. According to the findings of this research, it was found out that Turkish firms have cost-based management understanding and perceive financial/economic risks as the most important risk group. Although the contracting firms indirectly consider possible effects of project risks, they do not apply any risk management approach. However, clients withstand project risks via transferring most of them to contractors.

Keywords

Duration, Cost, Risk analysis, Risk management, Turkey

1. Introduction

Risks and their effects on project targets in construction are today one of the most discussed topics both in literature and in practice. There have been many different studies on this domain of construction (Dawood, 1998; Raftery, 1999; Mills, 2001; Rahman and Kumaraswamy, 2002; Raz and Michael, 2001; Williams, 1996). Similarly, numerous real-life examples on disputes related with cost and time overruns and poor quality exist in the Turkish construction industry. Although the industry has experience of this type of negative consequences, risk management is still ignored in Turkey and risks are not examined using systematic and sound methods. Therefore, risks available in the Turkish construction sector, effects of these risks on projects, and related precautions taken by contractors were considered in this study. To this aim, (i) planning techniques used in the industry, (ii) risk factors that cause cost and time overruns in projects, (iii) how these risks are evaluated in time and cost estimation processes at inception, and (iv) related inclinations and strategies of firms were determined.

2. Methodology

The numerical data used in the study was collected by means of a questionnaire survey which was applied to 68 companies (48.9%) out of 139 members of Turkish Contractors Association (Incir, 2003). In Table 1, types of projects that have been undertaken by the surveyed firms to date are given. It can be asserted that they do not limit their businesses to a particular project type, that they have executed projects in different types, and that they are large scale companies in general.

Table 1: Types of Projects Undertaken by the Surveyed Companies

Project Type	Experience in Business				Total (%)
	1-5 years (%)	6-10 years (%)	11-20 years (%)	> 20 years (%)	
Mass Housing	5.88	29.41	20.59	0	55.88
Infrastructure	0	8.82	8.82	0	17.65
Public Construction	2.94	32.35	29.41	2.94	67.65
Industrial Buildings	2.94	2.94	11.76	0	17.65
Highways	0	0	2.94	0	2.94
Touristic Facilities	11.76	26.47	14.70	5.88	58.82
Hydraulic Structures	0	5.88	2.94	0	8.82

Interviews composed of 15 questions were made face-to-face with project managers of contracting companies. In order to evaluate the survey in a detailed manner, Likert-type and multiple-choice questions were designed. In the analysis procedure, the frequency analysis and the relative importance index (RII) technique were employed. To perform these calculations in a quick and reliable manner, the SPSS software was used. In the frequency analysis, total number of answers for each alternative was converted to percentage values. In the RII method, the computation was carried out by the following equation,

$$RII = \frac{\sum_{i=1}^5 W_i X_i}{\sum_{i=1}^5 X_i} \quad (1 \leq RII \leq 5)$$

In this formula, ‘*i*’ is the order number of respondents; W_i – the rating given to each alternative by the respondents ranging from 1 to 5, with 1 representing ‘very unimportant’ and 5 representing ‘very important’; and X_i – the percentage of respondents scoring. The numerical values calculated by the above equation were then classified, because a single number changing from 1 to 5 in questions no longer symbolizes each verbal scaling expression in the evaluation phase. Hence, expressions of the 5-point Likert scale were defined via specific intervals, as given in Table 2 (David and Ronald, 1987).

Table 2: Resultant Intervals of Likert Scale

Very Unimportant (VU)	Unimportant (U)	Moderate (M)	Important (I)	Very Important (VI)
$1.00 \leq RII \leq 1.80$	$1.80 < RII \leq 2.60$	$2.60 < RII \leq 3.40$	$3.40 < RII \leq 4.20$	$4.20 < RII \leq 5.00$

3. Analysis of Findings

3.1 Planning Techniques

Highly competitive nature of construction industries leads to lower profit margins and thus more detailed planning efforts. In this regard, it is inevitable to utilize professional planning tools in construction scheduling. In Figure 1, whether Turkish construction firms use planning techniques was illustrated, considering the survey data. Most of the companies (85.29%) employ modern planning tools in projects, and attach adequate importance to this issue. The most preferred tool is bar charts (76.5%) because of its easiness to use, followed by popular planning methods such as CPM, PERT, and GERT (38.2%), project management softwares such as Ms Project and Primavera (11.8%), and resource utilization methods

(8.8%). These tools are relatively less employed when compared to bar charts. Moreover, none of the firms knows simulation softwares such as Monte Carlo and Risk Analysis. These findings point out the fact that the companies in the Turkish construction industry are not highly-informed about planning techniques.

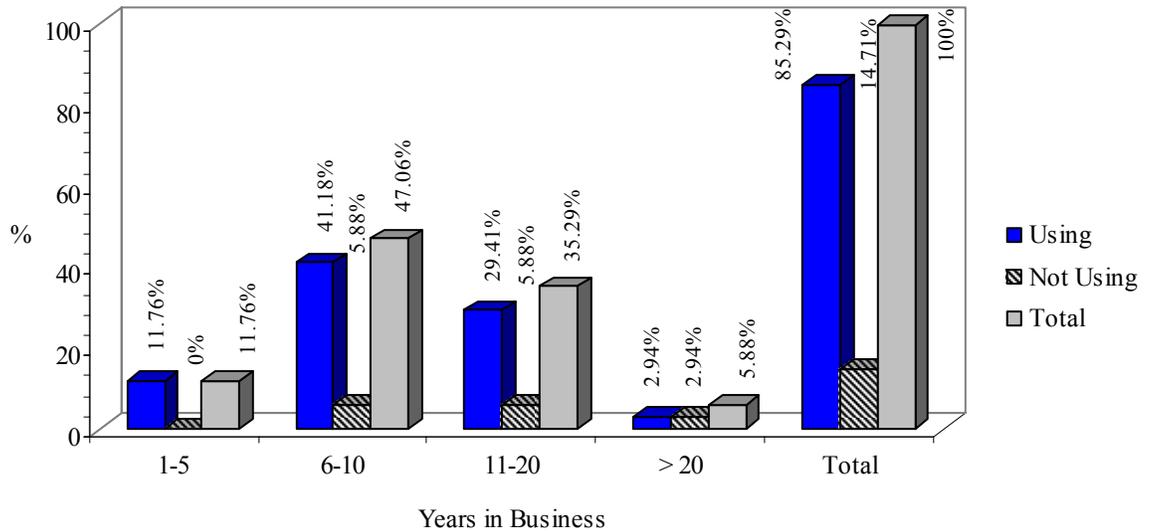


Figure 1: Usage of Modern Planning Techniques

In terms of planning and controlling efforts of the surveyed companies, a huge part of them (79.4%) fulfill these activities via their own planning departments (Figure 2). When Figures 1 and 2 are taken into account together, it is evident that a few contractors (5.88%) use planning tools although they have no planning departments. These firms and other contractors who do not employ planning tools perform planning and controlling activities by means of consultant firms.

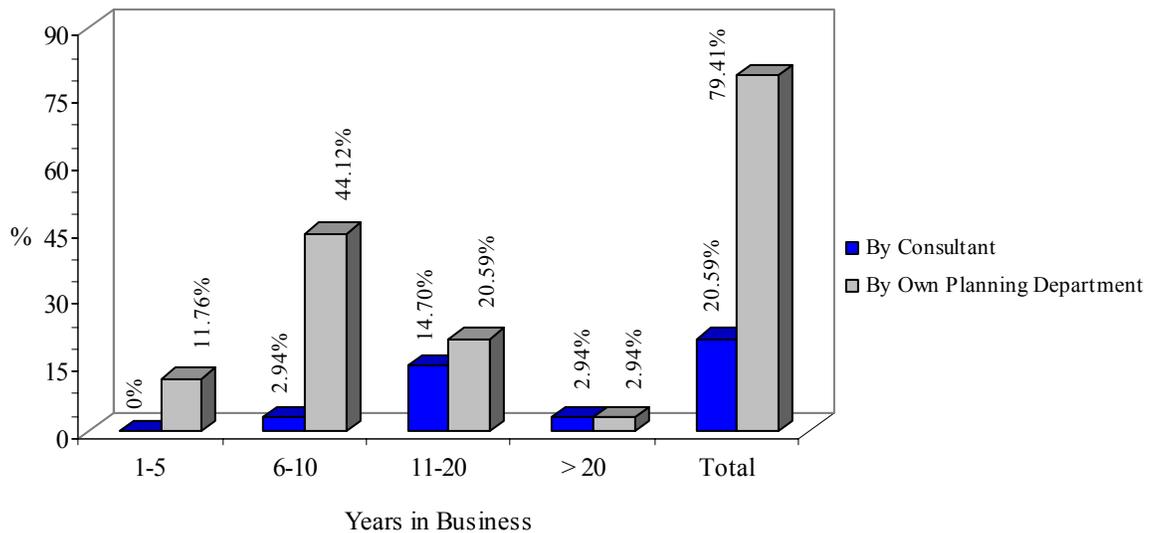


Figure 2: Execution of Planning and Controlling Activities

3.2 Cost and Time Planning

Today, planning has the utmost importance as a management function due to some factors such as increasing number of large scale projects, decreasing project duration allowed for construction, increasing

costs of production resources, and evolving nature of human resources. Three main criteria in construction planning are cost, time, and resources. As given in Table 3, these were evaluated by respondent firms, considering their importance levels. The most important criterion was found as cost, while duration has ‘moderate’ importance in the planning phase. However, planning efforts concerning resources are perceived as ‘unimportant’ by the participants.

Table 3: Importance of Project Planning Criteria

Rank	Planning Criteria	RII	Effect Level	Percentage of Respondents Scoring		
				≥ 4	3	≤ 2
1	Cost	4.50	VI	100.00	0.00	0.00
2	Duration	2.96	M	23.53	50.00	26.47
3	Resources	2.38	U	5.88	47.06	47.06
	Average	3.28	M			

While planning project duration, activities on the critical path are first determined. For this objective, all activities in the project and their time requirements are fixed to obtain total project duration. Amount of needed resources to complete each activity are then evaluated, considering data of previous project experiences in the same domain of construction. However, construction companies make some errors in cost and time planning as a result of depending on experience only. As the difference between planned and actual values grows, financial structures of contractors weaken. In practice, there are several approaches used by construction firms to compute total project duration. However, most of them have no systematic algorithms. In general, it is based on some approaches in which risk factors are either evaluated to some extent or ignored completely. As a result of the survey data, time planning is carried out according to the data of past projects (88.2%), analysis of all tasks (73.5%), and analogy (29.4%). In terms of cost planning data shown in Figure 3, related operations are mostly executed by unit price analyses (85.3%) and foreign currency based estimates (82.4%), whereas softwares (14.7%) in this field are rarely used.

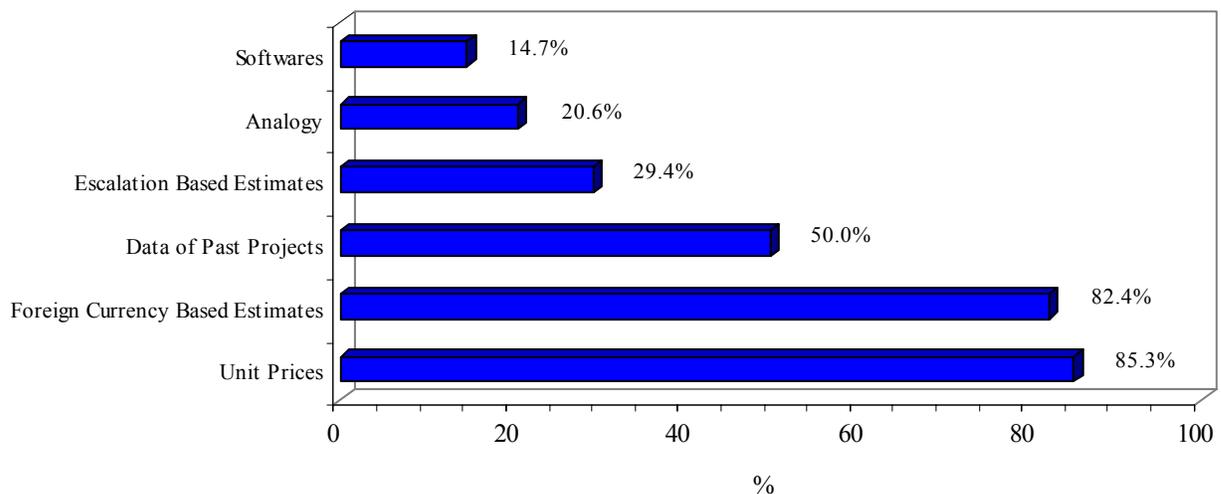


Figure 3: Methods for Determining Total Project Cost

In the application phase of projects, some factors such as site conditions, geological and topographical structures, and distance from population centres affect project cost, time, and quality. In addition, procurement of qualified labor and their permanent employment in the same companies have serious impacts on projects in construction. The approach applied by the surveyed firms to prevent risks is to add

estimated rough values to the final cost and time data in the planning stage (97.1%). This finding indicates that contractors do not use risk management tools that have technical and scientific bases. The other methods of evaluating risks are to employ past project data (41.2%) and to analyze all activities in detail (41.2%).

3.3 Project Risks

Contract and site management practices are facilitated by means of a detailed evaluation of risks in design and construction phases, creating applicable designs, suitable specifications, systematic project activities, and interactive site communication. Risks considerably influence budget, quality, time, and productivity of construction projects. It is impossible to completely remove project risks or to keep on working by neglecting them. As a solution, effects of risks can be reduced or risks can be transferred from one side to another. Risk management in construction covers a number of studies in which every kind of events that likely cause some deviations in project targets throughout the investment is quantified and preventive measures are taken. Therefore, proposals should be prepared according to potential risks and should include some measures that will not result in cost and time overruns even if risks come out. There are great similarities between the survey results of this Turkey-based study and of Akintoye and Macleod's (1997) England-based study. As a difference between the understandings of Turkish and English contractors about professional company management, contractor risks are seen as 'unimportant' in the Turkish construction industry, while it is 'moderate' in England. As a main finding of the present study, both financial/economic risks and construction risks were found to be 'very important', while natural disaster risks were described as 'very unimportant' in Table 4, despite the fact that very serious disasters have occurred in Turkey to date.

Table 4: Importance of Risk Factors

Rank	Risks	RII	Effect Level	Percentage of Respondents Scoring		
				≥ 4	3	≤ 2
1	Financial/Economic Risks	4.44	VI	97.06	0.00	2.94
2	Construction Risks	4.29	VI	88.24	11.76	0.00
3	Physical Risks	4.00	I	79.41	14.70	5.88
4	Design Risks	2.97	M	29.41	44.12	26.47
5	Political Risks	2.88	M	20.59	44.12	35.29
6	Legal Risks	2.85	M	17.64	47.06	35.29
7	Environmental Risks	2.68	M	17.65	38.24	44.12
8	Contractor Risks	1.91	U	0.00	17.65	82.35
9	Natural Disasters	1.00	VU	0.00	0.00	100.00
	Average	3.00	M			

Construction industries absolutely need to apply risk management practices, since construction projects contain many risk factors that change with type, size, complexity, and technology of projects and external environment. The most frequently encountered disputes in construction arise from delays, financial difficulties, and poor quality. According to the survey results, Turkish contractors attach more importance to the cost overrun problem than other two problems in projects (Table 5). Main reasons of cost overrun are large time extensions in unit price based projects and growing input costs such as material and labor. Although escalation coefficients are used in unit price based projects, firms' financial structures are immediately affected by cost increases. Accordingly, estimated costs in planning are lower than actual costs in completion. As can be seen in Table 5, another problem is late delivery of projects. Duration of construction projects in Turkey is usually determined by taking into account data of previous projects. However, this approach leads to incorrect estimates due to different characteristics of job sites such as

transportation and ground conditions. Therefore, project duration should be evaluated appropriate to the characteristics of the project region. Note that these features also have utmost effect on the project cost. Firms finally describe the problem of poor quality as ‘very unimportant’, and this judgment denotes contractors’ unhealthy points of view regarding quality management.

Table 5: Problems of Executed Projects

Rank	Problem Type	RII	Effect Level	Percentage of Respondents Scoring		
				≥ 4	3	≤ 2
1	Cost Overrun	4.10	I	76.47	20.59	2.94
2	Time Extension	3.40	M	47.06	32.35	20.59
3	Poor Quality	1.72	VU	0.00	14.70	85.29
	Average	3.07	M			

3.4 Preparation of Proposals

Profit margin suggested in a proposal is one of the most important factors influencing the award decision. A low level of the profit margin can cause the contractor to make financial losses. On the contrary, a high level of the margin can result in an unqualification decision. In this respect, contracting companies should evaluate a competitive profit margin while taking some measures against risk factors during construction and adding related contingency amounts to the margin. It is also necessary that cost and productivity analyses of past projects are taken into consideration in preparing proposals. According to the survey results, construction firms indirectly anticipate the potential effects of risks in their proposals in general, considering the criteria illustrated in Figure 4. Although especially social environment (26.5%) and supply-demand analysis (35.3%) have considerable impacts on projects, the surveyed firms inadequately pay attention to these criteria.

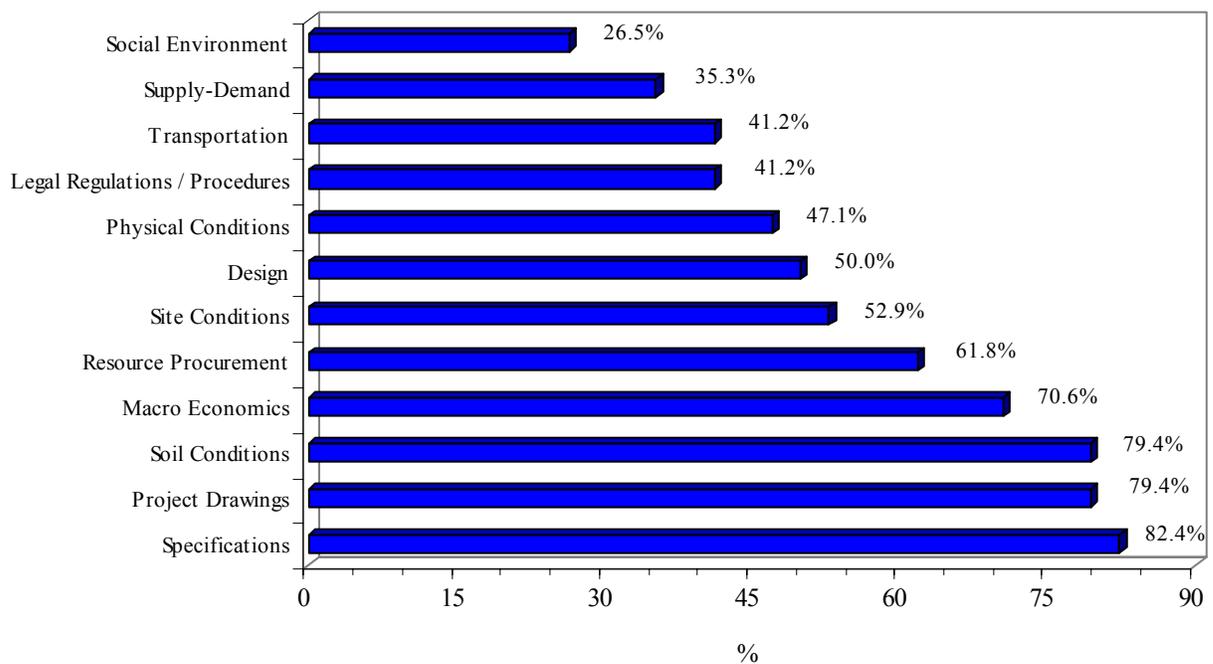


Figure 4: Criteria for Preparing Proposals

3.5 Risk Distribution in Contracts

Construction companies in Turkey do not attach required importance to contracts to be able to undertake projects or do not take the support of legal advisers while preparing contracts. Most of construction firms are not aware of which rights they hold in contracts, of which liabilities they commit, and of which responsibilities clients transfer to them. The survey data presented in Table 6 intend to introduce attitudes of the industry in reply to 28 different project risks which were determined by searching the risk management literature in construction.

Table 6: Distribution of Project Risks between Contract Sides

Risks	Contractor (%)	Client (%)	Both Sides (%)	Indefinite (%)
Resource Procurement	100.00	0.00	0.00	0.00
Disputes with Labor	85.29	0.00	14.70	0.00
Labor and Equipment Productivity	97.06	0.00	0.00	2.94
Coordination with Subcontractors	100.00	0.00	0.00	0.00
Accidents and Safety Regulation	97.06	0.00	2.94	0.00
Quality Production and Assurance	97.06	0.00	2.94	0.00
Accurateness of Schedules	79.41	0.00	20.59	0.00
Defective Materials	73.53	0.00	26.47	0.00
Variable Site Conditions	70.59	0.00	29.41	0.00
Adverse Weather Conditions	0.00	0.00	47.06	52.94
Inflation and Escalation	14.70	14.70	41.18	29.41
Late Payments	41.18	38.24	20.59	0.00
Strikes	14.70	8.82	11.76	64.70
Approvals and Permissions	14.70	38.24	47.06	0.00
Change Orders	50.00	20.59	29.41	0.00
Design Changes/ Imperfect Design	50.00	0.00	35.29	14.70
Natural Disasters	8.82	5.88	52.94	32.35
War/ Rebellion	0.00	11.76	55.88	32.35
Increase in Job Quantity	58.82	29.41	11.76	0.00
Transportation in Site	100.00	0.00	0.00	0.00
Delays by Third Parties	100.00	0.00	0.00	0.00
Delays in Dispute Solutions	38.24	0.00	44.12	17.65
Researches and Tests	52.94	0.00	47.06	0.00
Ecological Destruction	52.94	2.94	38.24	5.88
Taxes	35.29	26.47	38.24	0.00
Changes in Legislation	55.88	0.00	23.53	20.59
Bureaucratic Delays	61.76	11.76	20.59	5.88
Unanticipated Activities	52.94	17.65	29.41	0.00

It can be claimed that contractors take on risks in contracts in general and that clients transfer many risks to them. This can be accepted as a common proactive strategy of clients against risks. A clear indicator of this judgment is that contractors accept more responsibility than clients in 85.71% of risks. Contractors have full responsibilities in 14.28% of risks, and have no responsibility in 7.14% of risks. As the other side of contracts, clients accept more responsibility in 7.14% of risks only. They take on full responsibilities in none of risks, and have no responsibility in 57.14% of risks. In addition, mutual responsibility is bigger than other types of risk distribution in 25.00% of risks only. The whole

responsibility is transferred to both sides in none of risks, while responsibility is accepted by solely one side in 17.86% of risks. Contracts include great uncertainties in 7.14% of risks only, and they have no uncertainty in 60.71% of risks.

4. Conclusions

Contractors in the Turkish construction industry usually estimate unrealistic cost and time values in planning projects, and thereby the possibility of finishing projects successfully decreases. In order to have more healthy estimates in planning, risks that can be encountered throughout the investment should be analyzed in a robust manner. In this study, the current position of Turkish firms was introduced in terms of risk management and analysis, the causes of cost and time overruns in projects were determined, and related suggestions were presented to reach a solution. According to the results of the research, contractors perform planning and controlling activities via their own planning departments. In this process, they utilize modern planning techniques, but have no advanced knowledge of the issue. Furthermore, they indirectly evaluate the potential effects of risks while preparing proposals, and try to prevent risks by adding rough values to the planned final cost and time data. As another disadvantage, construction companies, in the planning stage, attach little importance to contractor risks and natural disaster risks in particular. In this context, Turkish contractors should employ both planning softwares and risk analysis tools. In terms of the risk management issue from the other side's point of view, it is obvious that clients attempt to withstand project risks by transferring them to contractors in contracts. Construction firms, nevertheless, should remove the disadvantage not only by offering clients reasonable solutions in the negotiation process but also by suitably arranging contract clauses via legal advisers. As an expected finding, Turkish companies perceive cost as the most important planning criterion and cost overrun as the most important project problem. Another evidence of these judgments is that financial/economic risks were found to be the most important risk group in practice. Although creating construction schedules that also consider cost is inevitable to complete projects successfully in today's competitive environment, it should be noted as a negative finding of this study that ignoring the problem of poor quality adversely affects cost. Therefore, contractors should take into account the triple constraint, i.e., cost, duration, and quality, even if their importance weights naturally change in every project, and they should investigate the means of optimization in this respect.

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