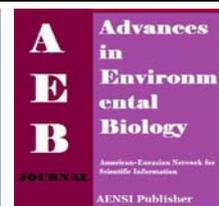




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## The Model of Optimal Combination of Resources to Improve the Performance of Technology-based Companies

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### ABSTRACT

Technology-based companies are always looking for factors that lead to improvement of their financial performance. For a long time, based on resource-based theory, the only available resources of a firm provided its financial performance and its competitive power and then working with other companies was known as an important factor in improving financial performance. But surely there are other unknown factors such as dynamic capabilities in this context that play the role of connector loop between firm performance and its financial resources. Therefore, this paper identifies factors affecting a technology-based firm's financial performance and competitiveness and the relationship between them. For this purpose 5 variables and main components displayed in conceptual model were detected and finally seven hypotheses were formulated. For field data collection, a questionnaire of 24 questions was designed and distributed among the population that was a number of steel manufacturing companies in Iran. Research method is functional in terms of its purpose and causal in terms of method. For data analysis, structural equation technique and LISREL software were used. The results showed that the sources of technology-based companies lead to increasing competitiveness and also increasing tendency of support companies to cooperate. The results also showed that tendency of support companies to collaborate and participate also leads to increasing the dynamic capabilities of technology-based (focal) companies.

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## INTRODUCTION

Technology is the most important factor in human's trafficking. The impact of technology on everyday life, economic and social structures and etc. indicates the necessity of full understanding of its various aspects and providing reliable predictive models more than ever before. It should be noted that science and technology also play an important role in various aspects of developing a country [1]. Technology is one of the most vital components of commercial and industrial organizations, and maybe that is why theoreticians have called economic and technology as economic engine and believe that companies are inevitable to technological develop and create advanced technologies for survival in competition arena. Given the importance of technology in the growth and survival of a firm, companies are in dire need of special attention and usage of new technologies, therefore, now there have been created a new type of companies that are based on technology and are called technology-based [2]. This study has focused on this type of companies. One of the most important issues that have been raised about these companies is that how and in what ways their performance can be enhanced or improved and increase competitiveness. It has been proved in many studies that the resource-based theory is a key aspect in technology-based companies in order to achieve and sustain competitive advantage and thus profit earning that leads to ownership of resources that are often valuable, rare, inimitable and irreplaceable [1]. These resources prevent competitors to get or imitate them and in this way resource-based theory leads to improvement of companies' and institutions' performance. In fact, this theory assumes a technology-based firm as a heterogeneous package of different resources that its growth and development depends on its various resources including the ability of management and skills and technical expertise [3]. But the important question that arises here is whether the resources (valuable, rare, etc.) guarantee proper financial performance for technology-based companies? Great economic giants such as Flip or IBM follow resource-based strategy for collecting and preserving technological assets, but according to rapid environmental changes in the present era it seems that noting resources alone is insufficient to obtain competitive advantage, however it

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seems necessary. Another question is whether there are shortcomings in the analysis of the resource-based theory? In other words, is the existence of other conversion processes possible between resources and performance that are now unknown and lead to improvement of functionality? In particular, resources should produce value-added and become competitive capability, thereby improve financial performance. Therefore, here we should identify and define a series of missed and unknown links that have a kind of connector role between resources and financial performance. This study attempts to identify these connector loops such as dynamic capabilities (the ability to integrate and transform internal and external sources) and tendency of support institutions to collaborate with technology-based companies.

#### *Research Literature:*

Before anything, defining key terms in this study are necessary:

#### *Dynamic capabilities:*

According to the definition provided by Tis et al (1997), dynamic capabilities are the ability to adjust or adapt to rapid environmental changes, in other words dynamic capabilities means that a firm can integrate, transform, or convert its resources [4]. The purpose of composition and coordination of various resources is acquiring and internalizing new knowledge from other organizations or transforming or converting existing resources to new or everyday process [1].

#### *Tendency of support institutions to participate:*

According to definition, internal resources of companies are limited and often insufficient, so companies pay attention to their surroundings to get their required resources [3]. For example, these companies that are also called focal companies depend on upstream suppliers to provide raw materials, downstream channels for delivery and research institutions to provide new technology [2]. Thus, institutions and businesses firms can provide their essential and complementary resources through various collaboration methods such as strategic alliances with support institutions (social capital theory focuses on the same subject).

#### *Competitive capabilities:*

These capabilities also refer to the ability of a firm to survive or surpass competitors by superior performance. Competitive capabilities of business firms are usually measured through criteria and indices such as innovation speed, speed of response to market needs, product quality, manufacturing flexibility and capability of research and development [5].

#### *Resource-based theory:*

A theory proposed by Penrose (1959). Penrose assumed companies as a set of heterogeneous resources that their growth depends on their various and diverse resources such as technical skills and management abilities [6].

#### *Technology:*

Technology is required knowledge, skill, technique, and tool to convert resources into products [7].

#### *Technology-based firms:*

Firms like Motorola and IBM that have a competitive strategy based on technology are considered technology-based [8]. These firms are pioneer and superior in creating new products, timely delivery, relative complexity of products, timely identification of emerging technologies and their use, considerable investments in research and development, high quality products, employees with high technical expertise and in general in innovation and technology management in competitive markets [2,9]. In general, presentation and development of resource-based view returns to 1959 and Penrose [7]. Penrose assumed firms as a package of heterogeneous and various resources and believed that their growth and development depend on these resources including the ability of management and technical skills [3]. Wernerfelt is known as the founder of modern resource-based view that he again drew attentions to the principle of resource situation inhibitor and considered a distinction between firm's resources that is shown as sustainable competitive advantage. Since then, and through the efforts of people such as Rumlet, Barney, Diarex Vogel and Grant, the resource-based view has become a key aspect in researches related to strategy formulation and theories like development of main capabilities and competitive strategy based on merit emerged [4]. It is necessary to explain that the resource-based view considers the resource collection a better strategy than the strategy of continuous setting of operation based on environmental changes and suggests that technology-based firms should set their competitive strategy based on their distinctive resources [10]. However, according to extortionate pace of technology and the fact that arrival of a technology sometimes leads to complete outdate of other technology, technology-based firms should increase their flexibility and achieve the ability to adapt (coordinate) quickly to environmental changes for survival [11]. This

ability is called dynamic capability under which companies can integrate, deform and convert their existing resources to gain a new knowledge from other organizations. Another important point is that according to the theory of social capital, resources of a technology-based firm are often limited and organizations focus on environment in addition to inside in order to get their required resources for example they rely on upstream suppliers to provide their raw materials [3]. These firms are called support firms that provide complementary resources for focal firms [10]. Firms often lack sufficient resources to grow and that is why they use collaborative methods such as strategic alliances and other strategies to provide complementary resources [11]. So, according to the theory of social capital, internal resources of a firm are insufficient to gain competitive advantage given the nature and network situation of current economic relations and focal firms need to cooperate with support firms in order to adapt to environment [12]. Rejecting resource-based and social capital theories is not the aim of this research; rather it attempts to amend the two paradigms by integrating them with dynamic capabilities.

#### *Developing hypotheses and conceptual model:*

As was mentioned before, the effect of converting resources of technology-based firms on relative improvement of their performance is considered in this study. Hence, by reviewing the literature of similar cases, conceptual model of research was designed and 7 hypotheses were formulated that show the relationship between the parameters. The cause of formation of 7-fold hypotheses between 5 main variables will be referred in summary. Resource-based view assumed firms as a set of heterogeneous resources that their growth depends on these various resources that should be valuable, rare and inimitable. In this way resources lead to better financial performance and income (the first hypothesis). According to the definition of dynamic capability (the ability to combine, match and reallocation of resources to acquire and internalize knowledge from other organizations), we should consider that the prerequisite for combining and converting existing resources is abundance of resources themselves, and according to the principle of absorptive capacity, existing knowledge affects the ability to absorb and acquire new knowledge in an organization (the second hypothesis). Resources enhance the competitive and dynamic capabilities, but according to insufficiency of a firm's internal resources, the firm needs to cooperate with other organizations such as companies supplying raw materials (the third hypothesis). Although factors like personal relationships between senior managers affects the creation of alliances and partnerships between companies, but major factor in establishing such alliance is the possibility of getting economic resources and income in future and this is how resources of focal firms affect the increase of support firms' tendency to cooperate (the fourth hypothesis). The final aim of integrating and converting resources and then acquiring and internalizing a new knowledge (dynamic capabilities) is upgrading a firm's ability to improve performance, survival and competition in a chaotic and turbulent environment (the fifth hypothesis). As was mentioned, complementary resources provided by support firms, either directly or indirectly (informational role), as well as other resources increase competitive capabilities (the sixth hypothesis). Although superior financial performance can be created through different ways like financial manipulation, capital selling or a monopoly position but logically there is a positive relationship between competitiveness and financial performance (the seventh hypothesis). According to what was proposed research hypotheses and conceptual model are derived as follows:

**H1:** Resources of technology-based firms increase their competitive capabilities.

**H2:** Resources of technology-based firms increase dynamic capabilities of technology-based firms.

**H3:** Tendency of support firms to collaborate and participation increases dynamic capabilities of technology-based (focal) firms.

**H4:** Resources of technology-based firms increase tendency of support firms to collaborate and participate.

**H5:** Dynamic capabilities in technology-based firms increase their competitiveness and competitive power.

**H6:** Tendency of support firms to participation increases competitiveness of technology-based firms.

**H7:** Competitive capabilities (competitiveness) in technology-based firms increase their financial performance improvement.

## MATERIALS AND METHODS

Method of this research based on the aim of research is functional and causal in terms of method, because it investigates effects of each effective factor on performance improvement using statistical technique of structural equation. Data were also collected through field method. It means that research data have been obtained visiting the members of population by researchers. Data gathering tool in this study is a questionnaire with 24 questions. All questions are designed based on Likert 5-option and Osgood 7-option scales (semantic). Research population was senior managers and heads of various offices in Khuzestan, Oxin and Kavian Steel Company that their number would exceed 425 people. 310 people from among the total number of members of the population were working in Khuzestan Steel Co. (73 percent), 68 people in Kavian (16 percent) and 47 people in Oxin (11 percent). According to Bartlett, the sample volume in structural equation modeling methodology can

be set between 5 and 15 observations per measured variable (question) to calculate the number of samples. Namely:

$$15q \geq n \geq 5q$$

in which:

$q$  = the number of observed variables (questionnaire's questions) and  $n$  is sample volume [13]. Data gathering tool in this study is questionnaire. The questionnaire of this research includes 24 questions. The number of required sample is calculated 120 samples, taking into account 5 required numbers of samples and also 360 samples taking into account 15 observations for each question. Accordingly, in this study, 200 questionnaires were distributed with stratified sampling proportional to size, and 160 questionnaires were also collected. Cronbach's alpha coefficient was used to check the reliability of article's questionnaire. So that researcher distributed the initial and confirmed 40 questionnaires among 40 samples and after collecting the value of Cronbach's alpha is calculated. The alpha value obtained for questions is 0.91 which indicates acceptable reliability of research tool. The confirmatory factor analysis was also used to determine the validity of the questionnaire. Confirmatory factor analysis is a reliable method for researcher to assess the structural validity. Confirmatory factor analysis examines whether the existing data fit the structure of severely limited pre-experimental that estimates similar conditions, or not. Based on confirmatory factor analysis, questions with greater t-statistic value than 1.96 are known to be significant and remain in the questionnaire [14]. As the results of the analysis are visible in Table 1, all questions have significant T-statistic value and there is no need to remove any of them.

**Table 1:** Confirmatory factor analysis results

Variable name	Questions	Factor Loading	T-statistic Values	Cronbach's alpha coefficient
Firm Resources	FR1	0.70	8.37	0.725
	FR2	0.39	4.59	
	FR3	0.52	5.91	
	FR4	0.60	6.08	
	FR5	0.57	5.17	
Competitive capabilities	CM1	0.71	*	0.739
	CM2	0.55	4.48	
	CM3	0.52	6.60	
	CM4	0.59	5.11	
	CM5	0.79	5.46	
	CM6	0.80	5.38	
Performance	PER1	0.70	*	0.781
	PER2	0.73	8.37	
	PER3	0.79	7.79	
	PER4	0.84	7.69	
	PER5	0.54	4.54	
Dynamic Capabilities	DC1	0.95	*	0.877
	DC2	0.97	8.64	
	DC3	0.99	9.18	
	DC4	0.87	8.46	
Tendency of support firms to participate	WSC1	0.74	*	0.828
	WSC2	0.76	9.34	
	WSC3	0.85	10.12	
	WSC4	0.82	10.26	

#### Research Model Fitting:

Before examining the hypotheses, we first examine the model fitting. Fitness is suitability and adequacy of the data for the model. This means that if the index of fitness indicates model fitness, data are adequate and suitable for analyzing conclusions of existing relationships in the model. Table 2 shows the indices of fitness.

**Table 2:** Indices of fitness

Chi-Square	456.73
Df	245
Root Mean Square Error of Approximation(RMSEA)	0.07
Normed Fit Index (NFI)	0.89
Non-Normed Fit Index (NNFI)	0.93
Comparative Fit Index (CFI)	0.94
Goodness of fit index (GFI)	0.80
Adjusted Goodness of Fit Index (AGFI)	0.86

#### Results:

Tables 3, 4 and 5 show sample demographic properties such as age, education and work experience:

Table 3: Number and percentage of respondents' age

Groups	Frequency	Frequency Percentage
Less than 25	11	6.8%
25 - 40	109	%68.2
More than 40	40	25%

Table 4: Number and percentage of respondents' education

Groups	Frequency	Frequency Percentage
Diploma	6	3.8%
Associate Degree	41	25.6%
BA	87	54.3%
MA	26	16.3%

Table 5: Number and percentage of respondents' experience

Groups	Frequency	Frequency Percentage
5 or less	31	19.4%
6-15 years	43	26.9%
16-20 years	66	41.2%
More than 20 years	20	12.5%

In this study statistical inference method was used to analyze data obtained. Research method was descriptive and statistical technique of structural equation modeling (Confirmatory path analysis) was used. Hypothesis of the model are tested after conducting confirmatory factor analysis and ensure of the model fitness. Significance of path coefficients between hidden variables is investigated using T-Student test. Since in this study confidence level of 0.95 or error level of 0.05 is considered, the positive path coefficients with the t-statistic greater than 1.96 is known to be significant and the research hypothesis related to them is confirmed. The results are shown in Table 6. The outputs of the software testing hypotheses are visible in figure 2 and 3. Figure 2 shows values of factor loadings (path coefficients) and Figure 3 depicts the obtained t-statistic values.

Table 6: Research Results

Hypothesis	Estimated path coefficients	t-statistic	Results
Hypothesis 1	0.72	3.37	confirmed
Hypothesis 2	-0.06	-0.46	rejected
Hypothesis 3	0.92	6.07	confirmed
Hypothesis 4	0.72	6.80	confirmed
Hypothesis 5	0.81	2.60	confirmed
Hypothesis 6	0.69	-1.87	Rejected
Hypothesis 7	0.77	5.09	confirmed

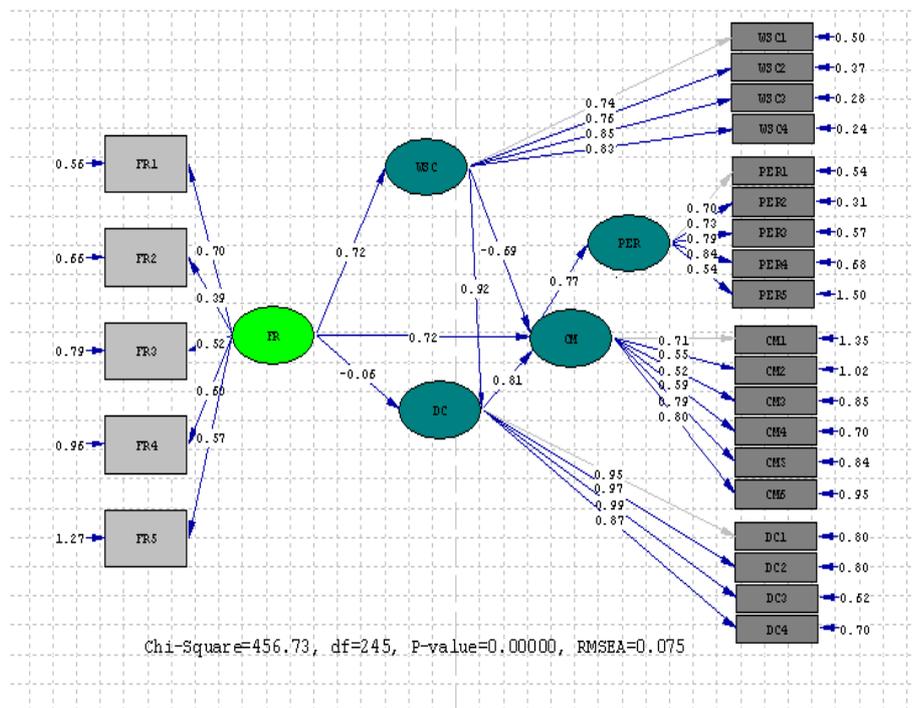
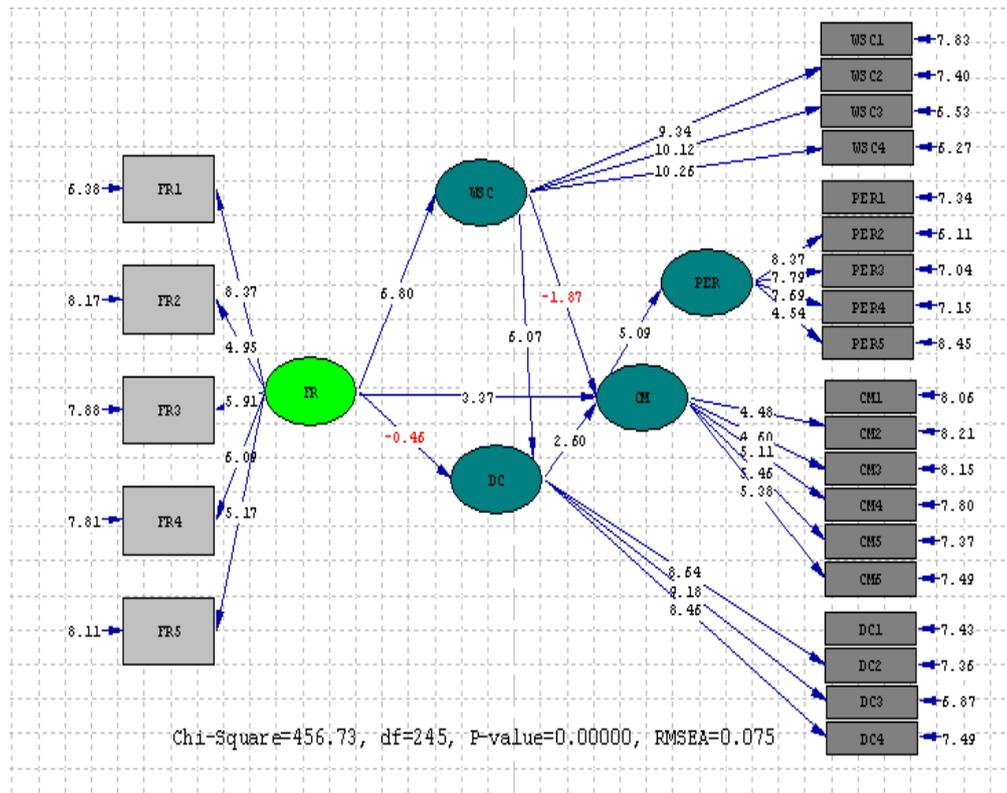


Fig. 2: Estimated value of each path coefficients



**Fig. 3:** T-statistic value for each coefficient

#### Conclusion:

After complete description of the statistical calculations in the section of data analyzing, the following results were obtained:

Acceptance of the first hypothesis means that base on the logic of resource-based view, if companies have a series of heterogeneous, strategic and rare resources, it certainly leads to their superiority and creation of a monopoly position and this finally increases their competitiveness or competitive capabilities. The second hypothesis states that if available resources of a firm increase its ability to combine and re-allocate increases, too. But the principle of impact of resources on dynamic capabilities is somewhat corrupted by rejecting the second hypothesis. So with rejecting the above hypothesis we conclude that increasing resources of a company will not necessarily increase its dynamic capabilities (although this hypothesis has been accepted in Chan's (2007) article). It was mentioned earlier that due to the competitive environment of current era and lack of environmental resources, firms cannot continue to exist alone, and need to communicate with other companies, including competitors, raw material suppliers and distributors to provide some kind of additional resources (due to insufficient internal resources). According to acceptance of the third hypothesis and the logic of social capital theory, if participation rate of a firm with other firms increase or in other words if tendency of support firms to communicate with these firms increase, firm resources increase consequently and according to the second hypothesis argument this leads to an increase in its dynamic capabilities. Acceptance of the fourth hypothesis shows that although various factors affect the formation rate of business partnerships and alliances among companies (including personal relationships between senior managers), but the most important factor is probability of achieving to economic benefits and profits in future for companies that accept participating, and one of the indicators of access to benefit in the future is existence of rich resources in a company, so if a firm's resources (including financial and technological) increase, the probability and willing of other firms to establish cooperative relationship with this firms increases. The ultimate goal of all activities taking place in a commercial or Product Company is integrating, structuring, reallocation of resources (dynamic capabilities), increase its ability to improve performance, survival and compete in a competitive environment and quite variable. Therefore, by accepting the fifth hypothesis, we understand that a company that has a high ability in the context of dynamic capabilities, consequently its competitiveness and capabilities to compete increases and it can perform better than competitors in the industry and excel them.

The sixth hypothesis rejection has a thought provoking point and is very vital. As mentioned earlier, support firms provide complementary resources for a firm in a way that this role can be direct (resource providing) or indirect (informational role). On the other hand, according to the acceptance of the third hypothesis, these

complementary resources increase dynamic capabilities and according to the fifth hypothesis these capabilities themselves lead to increase of competitiveness, therefore, by rejecting the sixth hypothesis we express that support firms (suppliers, distributors etc.) provide resources for firms that do not lead directly to increase of competitive capabilities rather this task is fulfilled through dynamic capabilities. Acceptance of the last hypothesis states that although improved or superior financial performance can be achieved through various ways but it is certain that if a firm's competitiveness increases its performance will totally and definitely increase. Thus, there is a strong and positive relationship between these two parameters. Also, if we wish to compare final results of rejection and acceptance of the 7-fold hypotheses of the current study with valid researches inside and outside the country, it should be explained that the only similar study (in this size) was the research of the two Taiwanese researchers (Lee & Chan) in 2007, investigating electronics and semiconductors industry that almost the same results were obtained. In both researches the 1<sup>st</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, and 7<sup>th</sup> hypotheses were accepted and the sixth hypothesis was rejected. The only difference between the two researches was related to the second hypotheses namely the impact of partnership variable on competitiveness that was accepted in Chan's (2007) research but its significance has not been approved in the current study. According to the final results of the hypotheses analysis, it is suggested that if firms intend to improve their financial performance, carry out the measures as follows:

First, companies must increase their resources through different ways including creating participation and ..., it is necessary to mention that natural resources are more considered that are somehow strategic, scarce and valuable and are considered as power source for firm and a pressure origin on competitors. It is also necessary to mention that given the current competitive and changing environment, companies must develop or enhance new kinds of capabilities and abilities called dynamic capabilities. These capabilities lead to adaptation to very rapid environmental changes and finally increase the competitive power of a firm (and consequently firm's performance). The main goal of dynamic capabilities is absorbing knowledge and novel technologies from external environment and its localization within a company that improves performance. In the context of competitiveness, it is necessary to explain that many factors (including the speed of innovation and investment rate in research & development) have been proposed for it and final results of the study showed that increasing resources or improving a company's abilities and dynamic capabilities will also improve the competitiveness and financial performance. Creating competitive advantage through dynamic capabilities requires continuous knowledge flows within and outside the organization and a kind of updated knowledge repository.

According to the researcher's study within the scope of the population of this research, any research has been done on this subject, therefore, it is recommended to future researchers that first get expertise and sufficient familiarity with the discussions and identify and investigate the probable variables between performance and resources that are ignored in this study. Limitations of this study include the lack of English and Persian resources on the subject, little familiarity of some of the members of the population with the subject, and finally impossibility of generalization of results to other times and places because of the samples belonging to a particular industry (steel making) and time.

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