Predicting Success Factors in Social Issue Crowdfunding Projects Using a Logistic Regression Analysis

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Abstract

This This study aims to provide quantitative evidence regarding the success factors of purchase-based crowdfunding for regional revitalization. While several studies have investigated success factors in crowdfunding, insufficient research has analyzed the success factors in the context of regional revitalization. Given the limited scope of regional revitalization, the success factors for projects may differ, making it an important research topic to conduct unique analyses focused on regional revitalization. This study proposes a predictive method for the success or failure of crowdfunding aimed at regional revitalization. The findings will be beneficial for utilizing crowdfunding in the context of regional revitalization.

Keywords: Crowdfunding, Logistic regression analysis, Success factors

1 Introduction

The aim of this study is to focus on crowdfunding projects addressing social issues and analyze success factors using text mining techniques. The motivation for exploring this issue is to seek solutions to the challenge of regional revitalization. The decline and revitalization of regional economies in Japan have long been recognized as serious social issues. Economic decline in regions leads to problems such as the migration of young people from rural areas, the hollowing out of shopping districts, and the underutilization of regional resources, perpetuating a cycle of further economic decline. To maintain regional vitality and tap into the potential of regions, sustainable regional revitalization strategies are needed. However, the financial resources available for regional revitalization are limited. Therefore, a framework for regional revitalization that is sustainable while minimizing financial resources is needed. One such framework receiving attention is the sharing economy [1]. The sharing economy promotes sharing rather than ownership, aiming to maximize resource utilization while reducing waste. However, the realization of the sharing economy requires shared resources within the community and mechanisms for their use. In regions where this is not established, the potential for revitalization through the sharing economy is limited.

On the other hand, crowdfunding enables access to resources both within and outside the region, supporting projects aimed at addressing regional challenges. Therefore, this study focuses on crowdfunding. Crowdfunding, a portmanteau of "crowd" and "funding," is a method of raising funds via the internet by soliciting funds from the general public who support the project's objectives. Given its nature, crowdfunding minimizes financial resources as project organizers do not

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need to have funds in advance, making it a promising method for regional revitalization. Crowdfunding allows project organizers to minimize financial resources because they do not need to possess funds in advance. Following the Great East Japan Earthquake, various types of crowdfunding initiatives, including donation-based, reward-based, and investment-based models, were active immediately after the disaster, facilitating individual livelihood reconstruction and aiding small and medium-sized enterprises in equipment purchases and operational funding [2].

Currently, numerous crowdfunding services are operated in Japan, including major platforms such as "Makuake," "READY-FOR," and "CAMPFIRE," which host diverse projects across various genres. In contrast, this study focuses on "GoodMorning," a crowdfunding platform operated by the major crowdfunding platform "CAMPFIRE," specialized in supporting individuals and organizations addressing social issues. When considering regional revitalization, focusing on projects in progress within such services is considered effective. Therefore, understanding success factors is crucial for promoting regional revitalization using crowdfunding. In this study, we aim to analyze success factors for crowdfunding projects aimed at regional revitalization using data from "GoodMorning."

Firstly, we utilize text mining techniques to analyze factors contributing to the success of projects aiming for regional revitalization. Specifically, based on the principles of descriptive statistics, we detect factors that are believed to influence the success or failure of projects. Next, we aim to construct a logistic regression analysis model that more accurately explains success factors for projects aimed at regional revitalization. Firstly, using scraping technology, we obtain a sufficient amount of data from "GoodMorning." Then, based on text mining techniques and the principles of descriptive statistics, we extract keywords from HTML data that are significantly related to success factors. Finally, using the selected keywords and factors as explanatory variables and success or failure as the dependent variable, we construct a model that can predict success or failure more accurately than conventional methods. The introduction section provides a comprehensive overview of the research context and objectives, highlighting the significance of the study in addressing the longstanding issue of regional economic decline and revitalization in Japan. The authors emphasize the need for sustainable regional revitalization strategies that minimize financial resources and identify crowdfunding as a promising framework for achieving this goal. They introduce the sharing economy as another framework receiving attention but note its limitations in regions where shared resources and mechanisms are not established. In contrast, crowdfunding enables access to resources both within and outside the region, making it a suitable focus for the study.

The authors provide a brief explanation of crowdfunding and its potential for regional revitalization, mentioning the numerous crowdfunding services operating in Japan and their focus on "GoodMorning," a platform specialized in supporting projects addressing social issues. They argue that understanding success factors is crucial for promoting regional revitalization using crowdfunding and outline their two-fold approach to analyzing these factors. Firstly, the authors aim to utilize text mining techniques to analyze factors contributing to the success of projects aiming for regional revitalization, using descriptive statistics to detect factors influencing project success or failure. Secondly, they aim to construct a logistic regression analysis model that more accurately explains success factors for regional revitalization projects. The authors describe their methodology, which involves obtaining data from "GoodMorning" using scraping technology, extracting significant keywords related to success factors using text mining techniques and descriptive statistics, and constructing a predictive model using the selected keywords and factors as explanatory variables and success or failure as the dependent variable. The introduction effectively sets the stage for the study, providing a clear and comprehensive overview of the research context, objectives, and methodology. The authors successfully communicate the significance of

the study in addressing the challenge of regional revitalization and the potential of crowdfunding as a promising framework for achieving sustainable revitalization with minimal financial resources. The section is well-structured and engaging, effectively guiding the reader into the subsequent sections of the paper.

2   Related Research

Research on the success factors of crowdfunding has made significant progress in accumulating insights. Miura et al. periodically checked Japan's major crowdfunding services, Makuake and READYFOR, collected data from 100 projects, and analyzed the success factors of crowdfunding [3]. The collected information included the "target amount," "number of support courses," "minimum support amount," "maximum support amount," and "benefits for funders," as well as the presence of a "video." They also recorded whether the fundraising was ultimately successful and created a decision tree for fundraising success or failure. The decision tree's target variable was the success or failure of fundraising, with the aforementioned collected information (e.g., target amount) as explanatory variables. Ultimately, they examined the success factors of crowdfunding based on the constructed decision tree, achieving an 83% match rate between actual success and predicted success. Based on these results, they revealed the significance of setting target amounts and utilizing active promotion through social media networks.

Yazaki et al., like Miura et al., investigated the factors leading to successful fundraising using data from crowdfunding platforms [4]. They utilized a Python program-based crawler for data collection and analyzed data from 7,959 projects collected from CAMPFIRE using statistical methods. They conducted multiple linear regression analyses using IBM SPSS Statistics 22.0, constructing four models with the dependent variables being "total support amount," "number of supporters," "achievement rate," and "per capita support amount." Explanatory variables included "target amount," "title character count," "duration," "introduction text character count," "activity reports," and "self-introduction text character count." Their analysis revealed that a higher target amount made success more challenging, while a more specific project description in the title and longer duration positively influenced success. Additionally, active PR efforts and communication with backers significantly contributed to success.

Uchida et al. compared the success factors of fundraising based on data provided by cloud computing platforms in Japan and the United States [5]. Their results indicated that an increase in the target amount and duration led to a decrease in the success rate of fundraising in both countries, while active PR efforts increased the success rate.

Furthermore, using data from "CAMPFIRE," researchers derived multiple patterns of successful crowdfunding projects and classified factors influencing pricing [6]. They designated the target variable as "success/failure" and identified explanatory variables such as "target amount," "duration," "returns," "minimum return price," "maximum return price," "CF project title (character count)," "CF project body (character count)," "video," "related URL," and "Tokyo location (binary variable)." Their analysis suggested that a higher target amount made success more challenging, while an increase in returns, maximum return price, and the presence of a video facilitated success. Moreover, they found that the minimum return price and Tokyo location had different effects on success depending on the pattern.

In summary, several studies have been conducted to investigate the success factors of crowdfunding. However, these previous studies have mainly focused on major crowdfunding services, and insufficient research has analyzed success factors in the context of regional revitalization.

Given the diverse nature of projects handled by major services, conducting unique analyses focusing on regional revitalization is crucial, as success factors are expected to vary within the limited scope of regional activity.

3 Predicting the Success or Failure of Crowdfunding

3.1 Data

In the creation of predictive models for crowdfunding aimed at regional revitalization, the introductory texts of 4,796 crowdfunding projects that ended between the inception of the service on GoodMorning and May 2, 2023, are analyzed. GoodMorning offers two methods of crowdfunding projects: the "All in" and "All or Nothing" approaches. With the "All in" method, even if the crowdfunding project's goal amount is not achieved, all the collected funds are received, provided that returns are also offered. On the other hand, the "All or Nothing" method refunds all collected funds to supporters if the support amount does not reach the target. Given the differing mechanisms between the "All in" and "All or Nothing" methods, the nature of projects is anticipated to significantly differ. Therefore, this study constructs independent predictive models for each method.

In GoodMorning, 2,544 projects (1,048 successful, 1,496 failed) adopt the "All in" method and 2,522 projects (1,021 successful, 1,231 failed) adopt the "All or Nothing" method. Furthermore, the success rate is slightly higher for the "All or Nothing" method at 45% compared to 44% for the "All in" method.

Similar to Uchida et al.'s study, this research utilizes logistic regression analysis with the outcome variable as success/failure and multiple explanatory variables to build predictive models. Following Uchida et al., the ratio of training data to validation data is set at 7:3. Therefore, for the "All in" method, 1,780 projects are used for training and 764 for prediction, while for the "All or Nothing" method, 1,906 projects are used for training and 616 for prediction.

The objective of this study is to develop a predictive model (hereinafter referred to as the proposed method) that outperforms the predictive model obtained from Uchida et al.'s study (hereinafter referred to as the conventional method).

3.2 Conventional method

Uchida et al.'s conventional method used success/failure as the dependent variable and included the following explanatory variables:

- Fundraising Goal: The target amount set for the project.
- Duration: The number of days the project was listed on the platform for fundraising.
- Returns: The number of patterns of returns set for the project.
- Minimum Return: The lowest amount among the returns set for the project.
- Maximum Return: The highest amount among the returns set for the project.
- Title Length: The number of characters in the project's title.
- Description Length: The number of characters in the project's description.
- Media: The total number of videos and images used in the project description.

- Related URLs: The number of URLs mentioned by the project's fundraisers in their profiles.
- Tokyo Location: A dummy variable set to 1 if the project's fundraisers are located in Tokyo and 0 otherwise.

These ten explanatory variables were utilized in their methodology. The conventional method achieved an accuracy of 73%, precision of 61%, recall of 36%, and an F1 score of 0.45 for predictions on "CAMPFIRE." To verify the predictive performance of this method in crowdfunding aimed at regional revitalization, the same explanatory variables were applied to the analysis of projects on GoodMorning. However, due to limitations in obtaining the duration variable from GoodMorning's specifications, this variable was excluded from the analysis in this study. Nonetheless, as Uchida et al. demonstrated that the duration did not significantly impact project success or failure, its exclusion did not affect the analysis.

The conventional method was then applied to predict the success or failure of projects on GoodMorning using the specified conditions. The results of the prediction and performance evaluation are presented in Tables 1 and 2, respectively.

Table 1: Prediction results of conventional method

Method	TN	FN	FP	TP
Conventional method	679	432	141	187
Conventional method(All)	338	227	70	79
Conventional method(A/N)	260	170	108	129

Table 2: Predictive evaluation results of conventional method

Method	Accuracy	Precision	Recall	F-measure
Conventional method	0.60	0.57	0.30	0.39
Conventional method (All)	0.61	0.53	0.26	0.45
Conventional method (A/N)	0.58	0.54	0.42	0.48

In Tables 1 and 2, "ALL" refers to the "All in" method, while "A/N" refers to the "All or Nothing" method.

The abbreviation TN represents True Negative, FN stands for False Negative, FP denotes False Positive, and TP indicates True Positive.

Initially, predictions were made by mixing the "All in" and "All or Nothing" methods. Consequently, the accuracy decreased by more than 10% compared to CAMPFIRE. Moreover, the recall rate also decreased accordingly. Subsequently, predictions were made using only the "All in" method projects. Since only "All in" method projects were used for predictions in CAMPFIRE, the subsequent results were compared with the conventional method's predictions in CAMPFIRE and were also used as a comparison basis with the proposed method. The confusion matrix (TN, FN, FP, TP) for the "All in" method showed very high values for TN and FP, representing the numbers predicted as failures, at 388 and 227 respectively, while FN and TP, representing the numbers predicted as successes, recorded very low values at 70 and 79 respectively. This indicates a strong tendency of the prediction model to predict projects as failures. Consequently, the recall rate, which indicates the probability of predicting successful projects as successful, dropped significantly to 25%. Thus, both predictions showed a strong tendency to predict projects as failures and had low recall rates, implying that the conventional model could hardly predict the

success of projects related to regional revitalization. The "All or Nothing" method showed a higher recall rate compared to the prediction performance in CAMPFIRE. The F-value also showed values comparable to CAMPFIRE, seemingly demonstrating equivalent performance. However, since the prediction in CAMPFIRE only targeted the "All in" method, claiming equivalent prediction performance in GoodMorning is difficult. Therefore, from this analysis, the conventional method was confirmed to be unsuitable for predicting crowdfunding projects with regional revitalization as the objective.

Furthermore, according to Uchida et al., the explanatory variables that influenced the success and failure of projects in CAMPFIRE were "target amount," "return," "maximum return value," and "video." In contrast, the significant explanatory variables in GoodMorning were "minimum price," "number of images," and "related URLs." Additionally, the partial regression coefficients indicating the influence of variables were consistently low across all explanatory variables. This suggests that the success factors for crowdfunding projects aimed at regional revitalization are different from conventional ones.

3.3 Proposed method

In the formulation of the proposed method, a set of 137 candidate explanatory variables was prepared. These candidate explanatory variables are as follows:

1: Explanatory variables used in the conventional method by Uchida et al.: 9 types. The following explanatory variables are those utilized in the conventional method. It should be noted that, for the previously mentioned reasons, the recruitment period has been excluded as an explanatory variable.

"Target amount", "Return", "Minimum return", "Maximum return", "Project title", "Project body", "Visual media", "Related URLs", "Located in Tokyo"

2: Explanatory variables related to project conditions and environment, similar to the conventional method: 9 types. The following explanatory variables are related to project conditions, information, and environment, and are aligned with the content of the explanatory variables used in the conventional method. Furthermore, except for the profile character count, the other explanatory variables are dummy variables, taking a value of 1 if the conditions are met and 0 otherwise.

- Profile character count: The character count of the profile of the organizer of the respective project.
- Urban or not: Whether the project was conducted in an urban area. Urban areas, in this context, are defined as Tokyo, as well as prefectures with designated major cities: Hokkaido, Miyagi, Saitama, Chiba, Kanagawa, Niigata, Shizuoka, Aichi, Kyoto, Osaka, Hyogo, Okayama, Hiroshima, Fukuoka, and Kumamoto.
- Corporation: Whether the project was organized by a corporation.
- NPO: Whether the project was organized by a non-profit organization.
- Experience: Whether the project organizer has posted one or more projects.
- Authentication: Whether the project organizer has verified using a Twitter account.
- Government URL: Whether a URL from a government-operated site (ending in .go.jp) exists in the project introduction.

3: Newly adopted explanatory variables in this study: 119 types. I

In this proposed method, in addition to the explanatory variables of the conventional method, new explanatory variables related to the content of crowdfunding projects are adopted. As a rule, dummy variables are used, where the explanatory variable is assigned a value of 1 if the variable

name is included in the text string, and 0 otherwise. The aggregation targets include the project name, project description, details of returns, and organizer profiles for each project.

Furthermore, some of the explanatory variables are based on the comparison of introductory texts between successful and unsuccessful projects, utilizing the text mining software Text Mining Studio (version 5.2).

Additionally, to account for similar expressions or variations in spelling, explanatory variables with multiple designated strings that correspond to a value of 1 are included. Moreover, variables such as "presence of URL" are included, where the variable name and the target string are not identical.

"The presence or absence of URLs", "Twitter", "Facebook", "Instagram", "Create", "Anime", "Sports", "Entertainment", "Disaster", "Animals", "Women", "Pets", "Events", "Offline", "Online", "Men", "Invitation", "T-shirts", "Stores", "Food", "Fireworks", "Commemoration", "Society", "Facilities", "Design", "Illness", "Cancer", "Patients", "Fighting illness", "Heart", "Corona", "Support", "Protection", "Future", "Reconstruction", "School", "Restoration", "Café", "Impossible", "Challenge", "First time", "Never give up", "Smile", "Fun", "Appreciation", "Wish", "Tourism", "TV broadcast", "Attract attention", "Delicious", "Award", "Red Cross", "Violence", "Crime", "Factory", "Discrimination", "Eradication", "Disparity", "Poverty", "Single-parent household", "Care", "Intellectual disabilities", "Developmental disabilities", "ADHD","ASD", "Visual impairment", "Hearing impairment", "Vulnerable", "Loneliness", "Death","Suicide","Extinction", "YouTube", "Channel subscription", "Elementary school", "Junior high school", "High school", "University", "Vocational school", "Pupil", "Student", "Nursery", "Kindergarten", "Waiting list for childcare", "Elderly home", "Connect", "Railway", "Bus", "Depopulation", "Declining birthrate", "Aging population", "Baby", "Toddler", "Wheelchair", "Barrier-free", "Universal design", "Employment support", "War", "Peace", "Social reintegration", "Culture", "Plan","Infertility","Premature baby", "President", "Environmental issues", "SDGs", "Energy saving", "Renewable energy", "Locally produced, "locally consumed", "Art", "Wine", "Sake", "Japanese sake"

In summary, while the conventional method utilized explanatory variables related to the amount of information such as the number of characters or images in the project description text, the proposed method additionally incorporates variables related to the content of the projects. This constitutes a significant difference.

Furthermore, some of the explanatory variables are based on a comparison of crowdfunding project description texts using the text mining software Text Mining Studio (version 5.2).

Although a vast number of 97 explanatory variables were prepared, not all variables were used at once. Only those explanatory variables with Wald statistic p-values generally less than 0.1, indicating significance, were selected, employing both the "All in" and "All or Nothing" approaches. Additionally, some variables without significance were included due to high absolute values of partial regression coefficients, indicating their influential potential (these variables are denoted with ※).

As a result, the "All in" approach resulted in a model using 25 types of explanatory variables: "Urban or not", "URL※", "Facebook", "Create※", "Sports", "Women※", "Fireworks", "Minimum price", "Visual media", "School", "Impossible", "Challenge", "Appreciation", "TV broadcast", "Single-parent household", "Intellectual disabilities", "Hearing impairment", "Vulnerable", "Death", "University※", "Kindergarten", "Elderly home※", "Baby※", and "President". The "All or Nothing" approach, on the other hand, yielded a model using 21 types of explanatory variables: "Experience", "Authentication", "Create※", "Online", "Minimum price",

"Impossible", "Challenge", "Appreciation", "Delicious", "Violence", "Vulnerable※", "Loneliness", "High school", "University", "Depopulation", "Baby", "War", "Peace", "Art※", "Wine", and "Japanese sake※".

Thus, using different explanatory variables with each approach enables the construction of distinct predictive models. The influence of each explanatory variable will be discussed in the subsequent analysis.

3.4 Prediction performance of the proposed method

The prediction results of the conventional method and the proposed method are presented in Table 3, while the performance evaluation results are depicted in Table 4. In Tables 3 and 4, "ALL" denotes the "All in" approach, while "A/N" signifies the "All or Nothing" approach.

Table 3: Prediction results of conventional method and proposed method

Method	TN	FN	FP	TP
Conventional method (All)	338	227	70	69
Proposed method (All)	365	200	75	124
Proposed method (A/N)	278	119	106	173

Table 4: Performance evaluation results of conventional method and proposed method

Method	Accuracy	Precision	Recall	F-measure
Conventional method (All)	0.61	0.53	0.26	0.35
Proposed method (All)	0.64	0.62	0.38	0.47
Proposed method (A/N)	0.67	0.62	0.59	0.61

Table 5: Confusion matrix of conventional method

	N	P
N	338	70
P	227	79

Table 6: Confusion matrix of the proposed method (All In)

	N	P
N	365	75
P	200	124

Table 7: Confusion matrix of the proposed method (All or Nothing)

	N	P
N	278	106
P	119	173

As mentioned earlier, the application of the conventional method to the data from "GoodMorning" has demonstrated its insufficiency in predicting the success of CF projects aimed at regional revitalization. In contrast, the results obtained using the proposed method for prediction have shown that both methods exhibited improvements in accuracy, precision, recall, and F1-score compared to the conventional method. Moreover, the numbers representing FN and FP, indicating the instances where success was predicted but failed, were comparable to other values, with FN being 75 and 106, and FP being 124 and 173 for the "All in" and "All or Nothing" methods, respectively. This suggests that the proposed method is more effective in predicting projects as successful compared to the conventional method.

Therefore, the proposed method can be concluded to be suitable for predicting the success of CF projects focused on regional revitalization.

3.5 Consideration of the proposed method

In the discussion, significant explanatory variables are addressed. As previously mentioned, the proposed method utilizes 137 candidate explanatory variables and primarily employs variables that were statistically significant for both "All in" and "All or Nothing" methods in the creation of predictive models. Analyzing the significance of each explanatory variable and their partial regression coefficients helps to understand the factors contributing to the success of crowdfunding for regional revitalization. While 25 explanatory variables were utilized for the "All in" method and 21 for the "All or Nothing" method, seven keywords were adopted as explanatory variables in both methods, including "create," "minimum price," "impossible," "challenge," "gratitude," "university," and "baby." Among these, the presence or absence of the keywords "minimum price," "impossible," "challenge," and "gratitude" were significant explanatory variables for both methods. Moreover, the partial regression coefficients indicated a positive impact of "impossible," "challenge," and "gratitude" in both methods.

For projects with keywords indicating "impossible" in the project description, phrases like "considered impossible" or "roles impossible for the administration" were frequently observed, suggesting the intent of achieving what was conventionally deemed impossible through the project. The presence of the word "impossible" in the description is speculated to encourage support. Similarly, projects with keywords indicating "challenge" often expressed the intention to challenge crowdfunding, conveying high motivation to potential supporters. Additionally, examples of project descriptions expressing gratitude, such as "I am now full of gratitude" or explanations regarding "thank you emails" as one of the returns, were prevalent.

However, several keywords were significant only for either the "All in" or "All or Nothing" method. This suggests that depending on the proposal, creators may need to choose the appropriate method. Specifically, 15 keywords were unique to the "All in" method, and 16 to the "All or Nothing" method, among which 14 and 12, respectively, were statistically significant.

In the "All in" method, words such as "single-parent household" and "hearing impairment" were significant for success. While "hearing impairment" had a positive partial regression coefficient exceeding 1, indicating a high success rate, "single-parent household" had a negative coefficient, indicating a decrease in success. Interestingly, although not significant, the coefficient for "single-parent household" was positive for the "All or Nothing" method. This suggests that conducting the same crowdfunding project under the "All in" method may not be suitable. Additionally, crowdfunding projects related to educational institutions showed positive coefficients for both universities and kindergartens, implying increased success rates.

For the "All or Nothing" method, keywords such as "art" and "wine" were significant for

success, along with others related to food and physical items, compared to the "All in" method. This suggests a higher success rate for the "All or Nothing" method. In projects related to educational institutions, both universities and high schools showed positive coefficients. Notably, high schools were not significant for the "All in" method, indicating a potentially higher success rate under the "All or Nothing" method.

4   Conclusion

This study addresses the longstanding and serious societal issue recognized in Japan as the challenge of "regional economic decline and revitalization." The authors direct their attention to crowdfunding as a mechanism, acknowledging it as a means of regional revitalization that minimizes the need for financial resources. The purpose of this research is to analyze the success factors of crowdfunding projects confronting social issues and to create predictive models for crowdfunding success. Leveraging data from GoodMorning, a leading crowdfunding platform on the internet, the authors aimed to analyze success factors and validate the predictive performance of crowdfunding for regional revitalization using the logistic regression approach.

The results confirmed that the conventional method was inadequate for predicting crowdfunding for regional revitalization. Consequently, the authors proposed a predictive method tailored to regional revitalization and validated its predictive performance. Notably, the proposed method differs from the conventional one by incorporating explanatory variables related to project content, alongside information within the project, as explanatory variables. The validation of the proposed method's predictive performance demonstrated improvements in accuracy across all four metrics: accuracy rate, precision rate, recall rate, and F-value, compared to the conventional method. Furthermore, the authors analyzed the differences in significance and influence of explanatory variables between the "All in" and "All or Nothing" methods. This analysis revealed variations in success factors and patterns between the two methods.

The aim of this study is to determine whether success or failure can be predicted from the data, and it does not address the subsequent activities of project implementers or their impacts.

5   Acknowledgement

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