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The Influence of Perceived Usefulness, Perceived Ease of Use, and Artificial Intelligence Integration on E-Commerce Adoption among Food MSMEs in Pasuruan City

Sinta Nuriyaningsih & Antin Rakhmawati
Universitas Yudharta Pasuruan, Indonesia
sintanuriyaningsih00@gmail.com; antinrakhmawati@yudharta.ac.id

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Abstract

The rapid development of digital technology has encouraged micro, small, and medium enterprises (MSMEs) to adopt e-commerce as a business development strategy. However, such adoption depends not only on technological availability but also on users' perceptions of its benefits, usability, and emerging technological capabilities. This study examines the effects of perceived usefulness, perceived ease of use, and artificial intelligence (AI) integration on e-commerce adoption among food MSMEs in Pasuruan City. Employing a quantitative explanatory design, the study involved 100 respondents. Data were collected through a structured questionnaire and analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS 4.0. The findings reveal that perceived usefulness has a positive and significant effect on e-commerce adoption, whereas perceived ease of use and AI integration have no significant effects. These results identify perceived business benefits as the primary factor underlying e-commerce adoption among food MSMEs in the study context. The study provides empirical evidence that the perceived value of digital technology may be more consequential to adoption than its perceived

usability or AI-enabled capabilities. Accordingly, MSME digitalization strategies should prioritize the delivery and communication of tangible business value, supported by continuous digital training, mentoring, and technological facilitation.

Keywords: Perceived Usefulness; Perceived Ease of Use; Artificial Intelligence Integration; E-Commerce Adoption; Food MSMEs

INTRODUCTION

The development of the digital economy has transformed the way businesses conduct marketing, transactions, and customer interactions. E-commerce represents one of the most prominent forms of digital transformation because it enables businesses to expand market reach, improve transaction efficiency, and overcome geographical limitations in accessing consumers (Putri Auliya et al., 2022). In Indonesia, the development of e-commerce has been supported by increasing internet access, digital skills, and technological infrastructure that enable individuals and businesses to participate in digital economic activities (Ariansyah et al., 2021). This condition provides strategic opportunities for Micro, Small, and Medium Enterprises (MSMEs) to utilize e-commerce as a means of strengthening business competitiveness. However, the availability of digital opportunities does not automatically ensure that MSMEs are able to adopt and utilize e-commerce effectively.

Food-sector MSMEs represent a particularly relevant context for e-commerce adoption because their products are closely associated with everyday consumption and serve broad consumer markets (Hilmi Arija et al., 2021). E-commerce can enable food-sector MSMEs to expand market access while improving the effectiveness of marketing and transaction activities (Wijaya et al., 2025). Evidence from Indonesian MSMEs further indicates that e-commerce adoption can contribute to business performance and financial inclusion, suggesting that digitalization involves more than simply changing sales channels and may also strengthen MSMEs' broader business capabilities (Wirdiyanti et al., 2022). Therefore, the central issue is no longer merely whether digital technologies are available, but how MSME owners perceive their usefulness, evaluate their ease of use, and respond to emerging technologies increasingly integrated into e-commerce ecosystems.

The present study takes the position that MSMEs' decisions to adopt e-commerce are influenced not only by technological availability but also by how business owners perceive

the value of the technology. Perceived usefulness is important because business owners are likely to consider whether a technology can generate tangible benefits for their business activities before deciding to use it. Davis, (1989) established perceived usefulness as one of the fundamental determinants of technology acceptance. Perceived ease of use is equally important because technologies perceived as difficult to operate may discourage adoption. These two constructs subsequently became central components in the Technology Acceptance Model (TAM), which provides a theoretically grounded explanation of technology acceptance behavior (Gefen et al., 2003).

The relevance of this perspective is particularly important for MSMEs because many of them operate under constraints related to financial resources, technological capabilities, and skilled personnel. Research on Indonesian SMEs demonstrates that perceived usefulness and perceived ease of use positively contribute to technology adoption intentions, while external support and trust may further shape technology acceptance (Nugraha et al., 2022). Research on digital technology users in Indonesia also indicates that individual innovativeness can influence technology adoption behavior (Setiawan et al., 2021). In the context of e-commerce, relative advantages, compatibility, digital skills, and infrastructure have likewise been identified as factors associated with adoption decisions (Saunila, 2020).

At the same time, the rapid development of Artificial Intelligence (AI) introduces a new dimension to e-commerce digitalization. AI can support personalized marketing, consumer analytics, content generation, product recommendations, and the automation of business activities (Dwivedi et al., 2021). For MSMEs, AI integration may strengthen their ability to conduct digital marketing and respond to consumer needs more efficiently. Recent evidence concerning AI adoption in e-commerce suggests that technological, organizational, and environmental factors can shape perceptions of AI, while perceived usefulness represents a particularly important driver of adoption (Rahmani et al., 2025). Consequently, incorporating AI integration into e-commerce adoption research is relevant because AI is not merely an additional technological feature but may reshape how MSMEs manage marketing activities and customer relationships (Astrini et al., 2020).

Previous studies have established a substantial empirical foundation for understanding digital technology adoption. Abed, (2020), for instance, found that perceived usefulness, top management support, and trading partner pressure were important factors in social commerce adoption among SMEs. Research on social commerce further demonstrates

that information quality, seller reputation, and transaction characteristics can influence consumer uncertainty in digital commerce environments (Al-Adwan & Yaseen, 2023). Al-Adwan et al., (2023) also demonstrated that TAM can be extended with additional constructs to explain intentions to adopt emerging technologies. These findings indicate that TAM provides a flexible theoretical foundation that can be adapted to different technological environments and research contexts.

Nevertheless, a research gap remains in the existing literature. First, studies of e-commerce adoption frequently examine perceived usefulness and perceived ease of use as technology acceptance constructs without explicitly incorporating the growing role of AI integration among food-sector MSMEs. Second, Indonesian studies have often examined digitalization, e-commerce, and fintech adoption separately, leaving relatively limited evidence concerning the integration of TAM constructs with AI-related technological developments in explaining e-commerce adoption (Rahayu & Day, 2017). Kilay et al., (2022), for example, examined the influence of e-commerce and e-payment services on MSME supply-chain performance rather than focusing on the perceptual mechanisms underlying e-commerce adoption.

Similarly, Wijaya et al., (2025) examined food-sector MSMEs through the TOE framework, emphasizing technological readiness, adoption costs, government support, and innovation capability. These studies therefore leave an opportunity to examine perceptual factors derived from TAM while simultaneously considering AI integration within the specific context of food-sector MSMEs.

The novelty of this study lies in developing an e-commerce adoption model that combines the two core TAM constructs perceived usefulness and perceived ease of use with Artificial Intelligence integration as a technological factor reflecting the latest development of digital commerce**.** This approach allows the study to examine not only whether MSMEs perceive e-commerce as useful and easy to use, but also whether their orientation toward AI integration is associated with their decision to adopt e-commerce. The integration of TAM and TOE perspectives has previously demonstrated potential for providing a more comprehensive explanation of technology adoption within organizational settings (Baker, 2012). In the present study, TAM serves as the primary theoretical foundation for explaining perceived usefulness and perceived ease of use, while AI integration represents a technological factor associated with the evolving e-commerce environment.

The focus on food-sector MSMEs in Pasuruan City provides a specific empirical setting for testing this model. The research background indicates that Pasuruan City has a substantial number of micro and small enterprises distributed across several subdistricts, with Panggungrejo having the largest number of such businesses. This business concentration provides a relevant empirical setting for examining digital transformation, particularly because food-sector MSMEs operate in markets closely connected to everyday consumer activities. Previous research on culinary MSMEs has also demonstrated the relevance of e-commerce, market orientation, and product innovation to marketing performance (Hardilawati et al., 2023).

Accordingly, this study focuses on the effects of perceived usefulness, perceived ease of use, and Artificial Intelligence integration on e-commerce adoption among food-sector MSMEs in Pasuruan City. Specifically, the study aims to examine the effect of perceived usefulness on e-commerce adoption, determine the effect of perceived ease of use on e-commerce adoption, and assess the effect of Artificial Intelligence integration on e-commerce adoption. The study is expected to contribute theoretically by extending the application of TAM to an AI-enabled e-commerce context and practically by providing evidence that can support MSMEs and policymakers in designing digitalization strategies that are more responsive to the needs of food-sector MSMEs.

METHODS

This study employed a quantitative approach with an explanatory research design to examine the causal relationships between perceived usefulness, perceived ease of use, Artificial Intelligence integration, and e-commerce adoption among food MSMEs in Pasuruan City. A quantitative approach was considered appropriate because all research constructs were operationalized through structured measurement instruments and the resulting numerical data were statistically analyzed to test the proposed hypotheses (Sekaran & Bougie, 2020). The research model was primarily grounded in the Technology Acceptance Model (TAM), which identifies perceived usefulness and perceived ease of use as central constructs in technology acceptance. Accordingly, the study examined three direct relationships involving the effects of perceived usefulness, perceived ease of use, and Artificial Intelligence integration on e-commerce adoption.

The research model comprised four variables: perceived usefulness (X1), perceived ease of use (X2), Artificial Intelligence integration (X3), and e-commerce adoption (Y). Perceived usefulness was operationalized using six indicators, while perceived ease of use consisted of three indicators. Artificial Intelligence integration was measured through eight indicators, and e-commerce adoption was represented by three indicators. The indicators of perceived usefulness and perceived ease of use were derived from the core constructs of TAM, representing users' beliefs regarding the benefits and ease of using the technology, respectively. The indicators of Artificial Intelligence integration reflected the utilization of AI within e-commerce activities, including support for customer services, recommendations, transaction security, and information processing. E-commerce adoption represented the readiness and willingness of MSME owners to accept and utilize electronic commerce platforms in their business activities.

The study population consisted of food MSMEs operating in Pasuruan City, including local culinary businesses, snack producers, and food-related MSME products that had entered modern retail outlets. According to data from the Pasuruan City Statistics Agency, the number of micro and small enterprises reached 31,668 units distributed across four districts. The sample size was determined using the Slovin formula with a 10% margin of error, resulting in a calculated sample size of 99.6, which was rounded to 100 respondents (Kock & Hadaya, 2018). The respondents were selected from food MSMEs operating in Pasuruan City because their characteristics corresponded directly with the research objective of examining factors associated with e-commerce adoption within the food sector.

Primary data were collected directly from respondents through a survey using a structured questionnaire. The questionnaire served as the principal research instrument and was developed according to the indicators specified for each research variable. Data collection was conducted by distributing the questionnaire to food MSME owners in Pasuruan City. The questionnaire items were designed to capture respondents' perceptions concerning technological usefulness, ease of use, Artificial Intelligence integration, and e-commerce adoption.

Before testing the structural relationships, the measurement instrument was evaluated through the outer model to establish construct validity and reliability. Convergent validity was assessed using *outer loading* values and Average Variance Extracted (AVE), while discriminant validity was examined through *cross loading* and the Fornell-Larcker criterion.

Construct reliability was evaluated using Composite Reliability and Cronbach's Alpha. The study adopted the criteria of *loading factor* ≥0.70, AVE ≥0.50, Composite Reliability ≥0.70, and Cronbach's Alpha ≥0.70.

Data analysis was conducted through descriptive and inferential statistical analyses. Descriptive analysis was used to summarize respondent characteristics and the distribution of responses across the research variables. Inferential analysis was subsequently conducted using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with SmartPLS 4.0 (Hair et al., 2019). The SEM-PLS procedure was used to evaluate both the measurement model (*outer model*) and the structural model (*inner model*). Structural model assessment involved *path coefficients*, *p-values*, R-square (R^2), *effect size* (f^2), and Q-square (Q^2) to evaluate the relationships among constructs, explanatory power, effect magnitude, and predictive relevance of the model.

RESULTS

The results section should be presented factually, systematically, and in a data-based

1. Path Coefficient

The *path coefficient* test aims to determine the direction and magnitude of the relationships between variables in the model. The hypothesis is accepted when the *p-value* is < 0.05.

Table 1. Path Coefficient

Hypothesis	Relationship Between Variables	Original Sample (O)	T Statistics	P Values	Decision
H1	Perceived Usefulness (X1) → E-commerce Adoption (Z)	0.705	7.520	0.000	Accepted
H2	Perceived Ease of Use (X2) → E-commerce Adoption (Y)	0.166	1.639	0.101	Rejected
H3	E-commerce Adoption (Z) → Marketing Performance (Y)	-0.080	0.700	0.484	Rejected

source: Compiled by the researcher (2026)

Table 1. Path Coefficient, Perceived Usefulness (X1) has a positive and significant effect on E-commerce Adoption (Z), with a coefficient of 0.705, *t-statistic* of 7.520, and *p-value* of 0.000. Therefore, H1 is accepted. Perceived Ease of Use (X2) does not have a significant effect on E-commerce Adoption, with a coefficient of 0.166, *t-statistic* of 1.639, and *p-value* of 0.101. Therefore, H2 is rejected. Artificial Intelligence Integration (X3) also

does not have a significant effect on E-commerce Adoption, with a coefficient of -0.080, *t-statistic* of 0.700, and *p-value* of 0.484. Therefore, H3 is rejected.

2. R-square (R^2) Test

Table 2. R-square (R^2) Test

Endogenous Variable	R-square	Adjusted R-square	Category
E-commerce Adoption (Z)	0.725	0.717	Moderate–Strong

source: Compiled by the researcher (2026)

Table 2. R-square (R^2) Test, E-commerce Adoption has an R^2 value of 0.725 and an Adjusted R^2 of 0.717. This indicates that 72.5% of the variation in E-commerce Adoption can be explained by the variables in the model, while the remaining 27.5% is explained by factors outside the model. Thus, the model has moderate-to-strong explanatory power.

3. F-square (f^2) Test

Table 3. F-square (f^2) Test

Relationship Between Variables	f^2 Value	Category
Perceived Usefulness (X1) → E-commerce Adoption (Y)	0.517	Large
Perceived Ease of Use (X2) → E-commerce Adoption (Y)	0.029	Small
Artificial Intelligence Integration (X3) → E-commerce Adoption (Y)	0.006	Small

source: Compiled by the researcher (2026)

Table 3. F-square (f^2) Test, Perceived Usefulness (X1) has an f^2 value of 0.517, categorized as a large effect. Meanwhile, Perceived Ease of Use (X2) has a value of 0.029, and Artificial Intelligence Integration (X3) has a value of 0.006, both categorized as small effects. Thus, Perceived Usefulness is the most dominant variable affecting E-commerce Adoption.

4. Q-square (Q^2) Test

Table 4. Q-square (Q^2) Test

Variable	Q^2 Predict	RMSE	MAE
E-commerce Adoption (Y)	0.706	0.555	0.453

source: Compiled by the researcher (2026)

Table 4. Q-square (Q^2) Test, the model has a Q^2 Predict value of 0.706, with an RMSE of 0.555 and an MAE of 0.453. The positive Q^2 value indicates that the model has good predictive capability for E-commerce Adoption.

5. Goodness of Fit Analysis

Goodness of Fit (GoF) analysis is used to assess the overall fit and explanatory capability of the structural model. In the PLS-SEM approach, the GoF value is calculated from the square root of the product of the average *Average Variance Extracted* (AVE) and the average *R-square* (R^2). Based on the SmartPLS results, the AVE values are 0.888 for E-commerce Adoption, 0.862 for Artificial Intelligence Integration, 0.869 for Perceived Ease of Use, and 0.873 for Perceived Usefulness, resulting in an average AVE of 0.873. Meanwhile, the R^2 value for E-commerce Adoption is 0.723, with an average R^2 of 0.694. The GoF calculation is as follows:

$$GoF = \sqrt{(AVE \times R^2)}$$
$$GoF = \sqrt{(0.873 \times 0.725)}$$
$$GoF = 0.677$$

The GoF value of 0.677 indicates a very high level of model fit. Based on the criteria of Tenenhaus et al., GoF values of 0.10, 0.25, and 0.36 represent small, medium, and large fit, respectively. Therefore, the value of 0.677 falls within the large fit category, indicating that the model has very good overall quality in explaining the relationships among the constructs. Thus, the structural model demonstrates a very good Goodness of Fit and is suitable for hypothesis testing and further analysis of the relationships among the research variables.

DISCUSSION

The findings demonstrate that perceived usefulness is the most influential factor in explaining e-commerce adoption among food MSMEs in Pasuruan City. The relationship is positive and statistically significant, as indicated by a path coefficient of 0.705, a *t-statistic* of 7.520, and a *p-value* of 0.000. This result suggests that the stronger the belief among MSME owners that e-commerce provides meaningful business benefits, the greater their tendency to adopt it. The finding therefore represents more than a statistical association; it indicates that digital adoption in this context is primarily driven by the value that technology is perceived to generate. This interpretation is further supported by an *effect size* of 0.517, which represents the largest contribution among the explanatory variables in the model.

From a substantive perspective, the finding indicates that MSME owners evaluate e-commerce largely in terms of its practical contribution to business activities. When digital platforms are perceived as capable of expanding market reach, increasing sales opportunities, accelerating transactions, or improving marketing efficiency, they become more relevant to business decision-making. This pattern is consistent with the Technology Acceptance Model, in which perceived usefulness constitutes a central determinant of technology acceptance. Davis, (1989) likewise emphasize the importance of perceived technological benefits in shaping technology acceptance. The present finding therefore reinforces the argument that e-commerce adoption among MSMEs is not primarily motivated by an interest in technology itself, but by the extent to which the technology can produce tangible business value.

The result is also consistent with the study of Nugraha et al., (2022), which is discussed in the thesis as evidence of the importance of perceived benefits in technology-use decisions. The consistency suggests that users are more willing to adopt digital technologies when the expected value is sufficiently clear. However, the present study adds a more contextual interpretation by examining food MSMEs in Pasuruan City, where the practical value of e-commerce may be closely related to market expansion and customer interaction. Perceived usefulness can therefore be understood not merely as a psychological construct within TAM, but also as an economic evaluation through which business owners assess whether a technology is worth integrating into their operations.

In contrast, perceived ease of use did not have a statistically significant effect on e-commerce adoption. Although the path coefficient was positive at 0.166, the *t-statistic* of 1.639 and *p-value* of 0.101 indicate that the relationship was insufficiently strong to achieve statistical significance. Its *effect size* of 0.029 also indicates a relatively small contribution. This finding is noteworthy because perceived ease of use is theoretically positioned as an important component of technology acceptance within TAM. Its lack of significance in the present context should therefore not be interpreted as evidence that usability is irrelevant, but rather as an indication that ease of use does not provide sufficient explanatory differentiation among the respondents' adoption decisions.

One possible explanation is that ease of use has become a relatively common characteristic of contemporary e-commerce platforms. When interfaces, navigation, and transaction processes are already sufficiently familiar and straightforward, differences in users' perceptions of usability may become less pronounced. As a consequence, ease of use

may no longer constitute the primary consideration in adoption decisions. The findings suggest that the explanatory strength of TAM constructs can vary according to the technological environment and user context. Once a technology reaches an acceptable level of usability, users may shift their attention from the question of whether the technology is easy to use toward whether it generates meaningful benefits.

This interpretation provides a more nuanced perspective compared with studies emphasizing usability as an important driver of technology acceptance. Dwivedi et al., (2021), for instance, associate advances in digital technology with improved user experiences through increasingly intuitive systems. However, the present findings indicate that usability alone may not translate into stronger adoption when users do not perceive sufficient additional value. The result therefore does not necessarily contradict the role of perceived ease of use, but suggests that its relative importance may diminish when users have already become accustomed to basic digital-platform functionality.

The third finding concerns Artificial Intelligence integration, which did not have a significant effect on e-commerce adoption. The path coefficient of −0.080, *t-statistic* of 0.700, and *p-value* of 0.484 indicate that the relationship was statistically insignificant. Its *effect size* of 0.006 further demonstrates that AI integration contributed very little to explaining adoption. This finding is particularly important because earlier research discussed in the thesis suggests that AI integration can support e-commerce adoption. Wijaya et al., (2025), for example, identified a positive relationship between AI integration and e-commerce adoption. The difference suggests that the mere presence of AI capabilities does not necessarily translate into adoption, particularly when users do not perceive those capabilities as providing immediate and meaningful value.

The result can be interpreted through the logic of TAM. AI represents a technological capability, whereas adoption is more directly associated with users' perceptions of usefulness and ease of use. Rahmani et al., (2025) suggest that AI integration can influence perceived ease of use and subsequently affect technology-adoption intentions. Nevertheless, if AI-enabled features such as recommendations, chatbots, personalization, or automation are not perceived as directly improving business activities, their presence may not substantially alter adoption decisions. Thus, technological sophistication does not necessarily equate to greater adoption attractiveness. In the context of food MSMEs, technological

functionality appears to matter less than whether that functionality is translated into observable business value.

The structural model provides additional support for this interpretation. The R^2 value of 0.725 indicates that perceived usefulness, perceived ease of use, and AI integration collectively explain 72.5% of the variance in e-commerce adoption, while the remaining 27.5% is attributable to factors outside the model. The Q^2 Predict value of 0.706 also indicates strong predictive relevance. Nevertheless, the unequal effect sizes demonstrate that the explanatory contribution of the predictors is not equivalent. Perceived usefulness clearly dominates the model, suggesting that the process of digital transformation among these MSMEs is more strongly associated with tangible business value than with usability or technological sophistication alone.

Theoretically, the findings strengthen the explanatory relevance of TAM by demonstrating that perceived usefulness can become substantially more influential than perceived ease of use within a specific MSME context. At the same time, the insignificant effect of AI integration suggests that extending a technology-acceptance framework with an emerging technological feature does not necessarily produce a direct adoption effect. AI may instead operate through intervening mechanisms such as perceived usefulness, trust, perceived risk, or digital capability. This interpretation is consistent with the directions proposed in the thesis for future research, particularly the inclusion of digital literacy, trust, perceived risk, and innovation capability as additional explanatory variables.

The practical implications are relevant to food MSMEs, local government, and digital-platform developers. For MSME owners, digitalization strategies should prioritize e-commerce functions that generate immediate business value, including sales, promotion, customer communication, and market expansion, rather than focusing primarily on technological sophistication. For local governments, digital-transformation programs may be more effective when training and mentoring explicitly demonstrate how e-commerce can solve concrete business problems. Platform developers should likewise ensure that AI-based functions are designed around actual MSME needs so that technological capabilities are translated into recognizable benefits. These implications are consistent with the recommendations in the thesis concerning digital-competency development, continuous mentoring, technology facilitation, and collaboration among government institutions, universities, and technology providers.

Several limitations should nevertheless be considered when interpreting the findings. First, the study involved 100 food MSMEs in Pasuruan City, meaning that generalization to other MSME sectors or geographical settings should be made cautiously. Second, the study relied on questionnaire-based responses, which capture respondents' perceptions at the time of data collection and do not necessarily reflect changes in adoption behavior over an extended period. Third, the model included only three explanatory variables, while the R^2 value indicates that 27.5% of the variation in e-commerce adoption remains associated with factors outside the model. Future research may therefore broaden the empirical setting, incorporate the additional variables suggested in the thesis, and employ longitudinal designs to obtain a more comprehensive understanding of how digital-technology adoption develops over time.

CONCLUSION

This study examined the effects of perceived usefulness, perceived ease of use, and Artificial Intelligence integration on e-commerce adoption among food MSMEs in Pasuruan City. Based on the PLS-SEM analysis, perceived usefulness was found to have a positive and significant effect on e-commerce adoption, whereas perceived ease of use and Artificial Intelligence integration did not demonstrate significant effects. These findings indicate that MSMEs' decisions to adopt e-commerce are more strongly shaped by the tangible benefits that digital platforms can provide for their business activities than by the ease of using the technology or the presence of AI-based capabilities. Perceived usefulness therefore emerges as the most influential factor underlying e-commerce adoption within the context examined.

Theoretically, the findings strengthen the understanding of technology acceptance by demonstrating the importance of perceived benefits in encouraging e-commerce adoption among MSMEs. From a practical perspective, the results emphasize that digital transformation initiatives should focus on technologies that generate tangible value through sales, promotion, customer communication, and market expansion. Food MSMEs should consequently strengthen their digital competencies through continuous training and mentoring, while local governments and relevant institutions should enhance technological facilitation, digital-transformation programs, and collaboration with universities and technology providers. Future research should extend the scope across different MSME sectors and geographical settings while incorporating additional factors such as digital

literacy, trust, perceived risk, and innovation capability. Longitudinal approaches and alternative theoretical frameworks, including UTAUT, DOI, or TOE, may also provide a broader understanding of how digital-technology adoption develops among MSMEs over time.

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