Crafting a Neutrosophic-Driven Tool to Probe Turnover Propensities in Manufacturing Entities

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Abstract

This research revolves around the development and validation of a tool, driven by Neutrosophic logic, designed to probe turnover propensities in manufacturing entities. The primary objective is to uncover the determinants of turnover in these organizations by assessing employees' intentions to leave. Initially, pilot interviews were conducted to identify turnover factors, and a synthesis of literature and interview insights led to the emergence of key themes. These themes were then utilized to construct a closed-ended questionnaire, which was subsequently employed in surveys. The instrument underwent validation through Exploratory Factor Analysis, confirming the validity of all items. Confirmatory Factor Analysis further established both convergent and discriminant validity, resulting in the exclusion of two items. This unique tool provides empirical researchers with a fresh approach to understanding turnover causes, particularly in the context of non-executive manufacturing personnel. Notably, the focus extends to addressing linguistic barriers by considering workers who may not be proficient in English, emphasizing the need for a scale catering to languages such as Urdu or Hindi.

Keywords: Turnover intent; Instrument; Development; Validation; Manufacturing organizations; Neutrosophic Insights; Neutrosophy

1. Introduction

Employee turnover, encompassing both voluntary and involuntary departures from organizational membership, has predominantly been examined in research studies through the lens of voluntary turnover. The literature employs various terms such as quits, attrition, exits, mobility, migration, and succession interchangeably with turnover. While turnover is generally perceived as having adverse effects on organizations, it is crucial to acknowledge functional turnover, indicating the departure of a productive employee choosing to leave an organization [30].

Recognizing the foundational role of employees in organizations, prioritizing their well-being becomes imperative, as their challenges can significantly impact organizational performance. Despite the potential detrimental effects of turnover, it is essential to note that turnover intention is an internal factor that can be mitigated and controlled through identification and corrective measures [39]. Identifying the reasons behind turnover intentions is crucial for addressing and rectifying issues affecting employees and, consequently, organizational dynamics.

In this context, crafting a Neutrosophic-Driven Tool emerges as a valuable approach to probe turnover propensities in manufacturing entities, offering a nuanced perspective to understand and manage this complex phenomenon [40].

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2. Rationale for development of scale

This study pertains to developing and validating an instrument for measuring employee turnover intention and its determinants in manufacturing organizations. Numerous factors are attributed to employee turnover and turnover intention in literature. Various instruments and scales are also used for measuring turnover. The commonly used scale Turnover Intention Scale (TIS) developed by Roodt mainly focused on measuring the extent to which an employee intends to leave an organization, and the scale suits to measure longitudinal study for measuring before and aftermath attitude of respondents. Seemingly there are not many valid and reliable scales for measuring turnover intention as concluded by Bothma and Roodt [16]. This study targeted the measurement of employee turnover intention of non-executive workers of the manufacturing organization. Most of the available scales measure turnover intention and causes of managers or teachers. Factors responsible for the turnover intention of such a cadre are different and mostly intrinsic. Therefore, such instruments were not found to be fit to measure turnover intention and determinants of turnover for non-executive employees of manufacturing organizations. On the other hand, most of the scales are in English, and almost all are in languages other than Urdu. Hence, employees of a country having Urdu or any similar language, e.g., Hindi, need a scale for their turnover intention measurement. Since non-executive employees don't have a better understanding of the English language. This gap requires an instrument that can measure the causes of employee turnover intention of nonexecutive employees of manufacturing organizations in their native language. Seven factors were identified from interviews and literature as determinants of turnover intention; hence it measures the validity of eight factors and their 32 scales.

3. Literature review

Research on employee turnover evolved in the 1900s when employees' concerns and contentment in different jobs were investigated by industrial engineers and psychologists. The era is called the era of the Industrial Revolution. There has been abundant literature about the causes/reasons for employee turnover.

Unveiling Turnover Complexities: Neutrosophic Insights in Manufacturing

Understanding turnover intentions in manufacturing is pivotal for organizational efficiency. Traditional methods, though prevalent, often fail to capture the multifaceted nature of turnover motivations [9]. Herein lies the potential of Neutrosophic logic, a paradigm introduced by Smarandache [40] that accepts degrees of truth, falsity, and indeterminacy. Wang emphasize its adaptability in understanding complex human behaviors. Davis & Clark identified multiple reasons for turnover [39], but as Alonso suggest, these factors interweave unpredictably. With Patel & Turner and Thompson & Lee showcasing Neutrosophic tools' promise, the need for a comprehensive instrument in this vein becomes evident.

Turnover intention

Maier stated that turnover intention denotes workers planned and voluntary propensity to leave their work and the organizations. Liu and Onwuegbuzie described substitute words for turnover intention i.e. propensity to leave, intent to leave, and intention to leave [8]. Ramli observed the intention to quit as an indication of actual turnover behavior in various turnover frameworks. Furthermore, Nyamubarwa claimed that numerous factors affect employees' intention to leave an organization: external environmental factors, including economic state of affairs, and the factors involved in molding and evolving employee turnover in the labour industry; individual factors, which are specific to the individual employee; and organizational factors concerning organizational policies and practices.

Reward & benefits

Rewards and benefits have been widely linked to motivation and negatively linked to the intention to quit a job. According to Shukla and Sinha and Gee and Hanwell, there will be little motivation to continue a job when an employee is working for poor rewards with inadequate benefits. While investigating the turnover of employees working in the Ethiopian Evangelical Church, Mekane Yesus Melaku determined that salary and benefits packages have a strong effect on the decision to leave or remain a member of an organization. Similarly, Jabber and Mesbah-Ud-din found employee turnover intention and employee dissatisfaction with rewards are strongly positively correlated [38]. Al-Suraihi, Samikon, Al-Suraihi, and Ibrahim have also mentioned low wages as a reason for employee turnover [5]. Likewise, Singh and Loncar argued that turnover intention and actual turnover increase due to pay disparity or injustice among employees who have the same qualifications and experience.

Job security

Job security dominates an individual 's personal, professional, and social life since it provides relief to individuals from being uncertain and worried about the future. It also helps retain a peaceful environment and harmony, enhancing organizational efficiency, and keeping values and morals. Falatah recommended enhancing job security to mitigate the negative effect of turnover [22]. Likewise, the findings of Obeng, Quansah, and Boakye show a positive relationship between job insecurity and turnover intention. They also concluded that job insecurity is an antecedent of turnover intention. Khan asserted that there is a significant and negative influence of job security on employee exit from the

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organization [39]. Likewise, job security was identified as the most influencing factor for employees by Makhdoom. Whereas, Makhdoom identified job security as the second highly affecting factor on turnover intention in the textile industry. On the contrary, Makhdoom concluded that job security does not have a strong relationship with turnover intention while investigating the turnover intention of employees in the sugar industry. Similarly, Nyanjom conducted a study on state corporations in Kenya and suggested that job security influenced employee retention. On the other hand, Tanchi claimed that job security looks a significant factor, but lack of job security will not affect employee turnover.

Workplace environment

The workplace environment refers to the physical space that surrounds employees during their work and has been immensely emphasized by researchers and industry experts. Kwame asserted that a "lack of good working conditions" is one of the causes of labour turnover in Zoomlion Ghana Limited [8]. Similarly, Albaqami also concluded that an improved working environment may lead to job satisfaction among faculty members and will reduce turnover intention, after researching Saudi public universities [2,10]. Al-Suraihi identified the poor working environment as a factor affecting turnover [5]. Similarly, Al Sabei emphasized that working in a favorable environment was associated with less turnover intention [3]. Aqeel, Wahaba, and Rizwan concluded that whole industries in the Site area Kotri producing pollutants, especially the textile, cotton, and flour mills, produced much higher values of a pollutant than the others in the vicinity area of the industries [7,12]. Industries that require a high labor-to-capital ratio require a lower ratio of labor to capital [26]. Ghanghro conducted a comparative study on industry workers and the healthy normal group and concluded that industrial workers are prone to suffer from mild asthma and other respiratory problems due to harmful chemical levels induced by inhalation in Site Area, Kotri [29,13]. Siddiqui described that the European nations and International Labour Organization are working on the improvement of institutional mechanisms for productive labour inspection systems and the promotion of the safety culture in Pakistan. Focus on personal health, psycho-social environment, and physical environment through the involvement of the entire community was strongly recommended by The World Health Organization (WHO).

Management style

Researchers argue that supervisors and managers have an important impact on employee turnover. Makhdoom, Shaikh, and Baloch concluded that employees get irritated by the unfavorable behavior of their boss and continue working in an organization under the supervision of a friendly boss. Makhdoom and Daas have emphasized leadership style for analyzing employee job behavior [40]. Similarly, Yücel emphasized that employees who are supported by their leaders are generally less likely to have turnover intentions. Whereas Al-Suraihi attributed poor leaders and managers as one of the causes of turnover [4,17]. Whereas Michael emphasized improving leadership for reducing turnover. Likewise, Wibowo and Paramita stressed that mindful leadership can reduce turnover intention. They found after twelve months, turnover intentions declined and almost three years later, the risk of voluntary turnover also decreased because of the supervisors' support initiative. While conducting a study, Caillier concluded that transactional-oriented leadership — characterized using disciplinary power and maintenance of the normal flow of operations — tends to increase quits in organizations [18]. Whereas transformational-oriented leadership — where the focus is on encouragement, teamwork, and cooperation with subordinates to achieve transformation for betterment — was found to lower voluntary turnover [40].

Alternate job opportunities

In a recent study, Živković, Fosić, and Vorkapić found low rates of turnover intention, with a simultaneous perception of very few or weak possibilities for alternative employment. Likewise, Awal and Baranchenko also opined that external employability strongly impacts turnover intention [11,14]. Whereas Albalawi stressed that perceived alternative job opportunities are out of control for organizations and have a positive correlation with turnover intention [1]. On the other hand, Khan reported that a lack of external job opportunities compels employees to maintain organizational membership, even though against a stressful working environment, however, technological advancements boost the economy and create new jobs [6,39,25]. According to Gee, employees don't opt to quit their jobs irrespective of the degree of job satisfaction, because of the lack of alternate jobs available in markets [28,20,25]. According to Skachkova, alternate job opportunities force employees to leave organization by terming it alternate forces among the set of other forces while analyzing voluntary turnover among technical consultants in Sweden. Similarly, Hussein investigated the industrial sector of the West Bank and concluded that the availability of other jobs in surroundings or proximity is deemed as one of the most impacting factors for labour turnover [37]. Farooqui and Ahmed conducted a descriptive and cross-sectional study with a sample of 160 randomly selected respondents using a closed-ended questionnaire on a 5 points Likert scale [23,24]. they concluded that reward and benefits, working environment, job security, management style, and job opportunities along with fifteen other variables as significant causes of turnover in the textile industry in Pakistan.

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4. Research methodology

This study underwent two methods for data collection: interview and survey questionnaire.

Interview

Though various determinants of turnover intention were identified from the literature, it was imperative to identify the factors found in a manufacturing organization that pertains to the population of the study. As a pilot study, semi structured and sequential interviews were conducted to discover the most common answers, determine the variables, and identify the determinants/causes of employees' turnover intention perceived by the managers and employees of Site area Kotri. A total of 11 employees were interviewed until the saturation point was met. The occurrence of saturation with 12 participants was reported by Guest, Bunce, and Johnson, whereas the occurrence of saturation with 11th participants was proposed by Latham. The sample for interviews was selected through the convenient sampling technique. The responses of participants were transcribed on hand notes in Urdu. Afterward, codes were generated, themes from the code were searched and reviewed, and finally, names were given to the themes. Six themes developed through the responses of interviewees were identified as factors causing/determining employee turnover intention in the manufacturing organizations working in the Site area, Kotri. The factors are listed in column 1 of Table 2. Except for job insecurity, which was emphasized in the literature but could not be found in the findings of interviews, the two factors that were not found in the literature, namely, overtime unavailability and attraction to gratuity withdrawal, were exclusively identified as determinants of employee turnover intention in the findings of the interviews. The remaining four factors have been identified from the review of the literature and findings of the interview as well. The summary of factors identified as determinants is presented in Table 1.

Table 1: Factors identified as determinants of employee turnover intention

Number	Factors identified in interviews	Factors identified in the literature	Factors not identified in the literature review	Factors not identified in the interview
1	Poor Reward & Benefits	Poor Reward & Benefits	Overtime unavailability	Job insecurity
2	Unfavorable Workplace Environment	Unfavorable Workplace Environment	Attraction to gratuity withdrawal	
3	Unconducive Management Style	Unconducive Management Style		
4	Alternate Job opportunities	Alternate Job opportunities		
5	Overtime unavailability	Job insecurity		
6	Attraction to gratuity withdrawal			

Source: Developed by the authors

Questionnaire development

A closed-ended questionnaire was developed comprising 32 items, measuring the eight variables, and four items measuring one variable. The questionnaire comprises items for measuring eight variables identified as determinants in literature and from the results of interviews.

For a single construct, three items or above were suggested by scholars, as the construct's theoretical domain can get minimum coverage [31,28]. Since most of the respondents were less educated or uneducated, the length of the questionnaires was set short to facilitate respondents, and each construct is measured by four items. The validity of the content in the questionnaires was reviewed and confirmed by industry experts. For ascertaining the content validity and readability of the instrument, experts' opinions were taken, and the questionnaire was improved and modified accordingly. For measuring the response of participants, five response points were provided from 1 to 5 (Likert Scale), representing the lowest point with strong disagreement and the highest point with strong agreement. Amin and Akbar, Farooqui & Ahmed and Knight and several other studies in the literature on turnover used the same scale [6,23,40].

Reliability of instrument

A pilot study was conducted initially on a sample of 40 respondents, to ascertain the reliability of the instrument, by knowing the one-dimensionality and internal consistency of the items measuring a particular construct. Hill advised a

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sample of 10 to 30 for the pilot survey [35]. Cronbach's Alpha was computed, to evaluate the instrument's reliability, as suggested by Chun-Chang Lee with values ranging from 0.75 to 0.93. Whereas the values ranging from 0.70 to 0.95 were suggested by Tavakol and Dennick. Cronbach's alpha is a popular and reliable internal consistency measurement used in the social and organizational sciences [15,29]. Scholars noted a score of 0.80 and above is considered an acceptable level of reliability for Cronbach's alpha. Before analyzing the construct validity of the instrument, it was crucial to measure its reliability in terms of internal consistency and Unidimensionality among the items measuring a particular construct.

Table 2: Cronbach's alpha for the questionnaire of turnover intention and its determinants (n = 40)

Variable	Cronbach's Alpha	N of Items
Turnover intention	.885	4
Poor Rewards & Benefits	.793	4
Job Insecurity	.828	4
Unfavorable Workplace Environment	.904	4
Unconducive Management Style	.832	4
Alternate Job Opportunities	.862	4
Overtime Unavailability	.796	4
Attraction to Gratuity Withdrawal	.730	4

Source: Developed by the authors

As shown in Table 2 Cronbach's alpha values are greater than 0.7, for all variables identified that will be used for measuring employee turnover intention and its determinants and are in accordance with the recommended criterion of 0.7 by Hair [31,34]. Hence, one-dimensionality and internal consistency among all items of particular constructs of this scale have been ascertained.

Questionnaire administration

Data was collected by filling out 342 questionnaires from four leading industries in the Site Area, namely; Textile, oil, flour, and paper. A total of 12 mills, three from each of the industries mentioned above were visited. Hence, 105 questionnaires from textile mills, 102 questionnaires from oil mills, 57 questionnaires from flour mills, and 78 questionnaires from paper mills were filled out.

The questionnaire was prepared in the Urdu language, keeping in view the convenience of respondents. Approximately 25 percent of the respondents were not able to fill out the questionnaires, because they were less educated or uneducated. Hence, research assistants were hired for filling out the questionnaires, they were reading the items and options, and recording the responses.

5. Preliminaries

Neutrosophic set can be applied in various real-world applications. In this part, we introduce some type 2 neutrosophic set definitions as:

$$X_1 = \left\{ \begin{array}{c} \left(T_{T_{x_1}}(y), T_{I_{x_1}}(y), T_{F_{x_1}}(y) \right), \\ \left(I_{T_{x_1}}(y), I_{I_{x_1}}(y), I_{F_{x_1}}(y) \right) \\ \left(F_{T_{x_1}}(y), F_{I_{x_1}}(y), F_{F_{x_1}}(y) \right) \end{array} \right\}$$

$$X_2 = \left\{ \begin{array}{c} \left(T_{T_{x_{12}}}(y), T_{I_{x_2}}(y), T_{F_{x_2}}(y) \right), \\ \left(I_{T_2}(y), I_{I_{x_2}}(y), I_{F_{x_2}}(y) \right) \\ \left(F_{T_{x_2}}(y), F_{I_{x_2}}(y), F_{F_{x_2}}(y) \right) \end{array} \right\}$$

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$$X_1 \oplus X_2 = \left\{ \begin{array}{c} \left(\begin{array}{c} \left(T_{T_{x_1}}(y) + T_{T_{x_2}}(y) - T_{T_{x_1}}(y) \cdot T_{T_{x_2}}(y)\right), \\ \left(T_{I_{x_1}}(y) + T_{I_{x_2}}(y) - T_{I_{x_1}}(y) \cdot T_{I_{x_2}}(y)\right), \\ \left(T_{F_{x_1}}(y) + T_{F_{x_2}}(y) - T_{F_{x_1}}(y) \cdot T_{F_{x_2}}(y)\right) \end{array} \right), \\ \left(I_{T_{x_1}}(y) \cdot I_{T_{x_2}}(y), I_{I_{x_1}}(y) \cdot I_{I_{x_2}}(y), I_{F_{x_1}}(y) \cdot I_{F_{x_2}}(y)\right), \\ \left(F_{T_{x_1}}(y) \cdot F_{T_{x_2}}(y), F_{I_{x_1}}(y) \cdot F_{I_{x_2}}(y), F_{F_{x_1}}(y) \cdot F_{F_{x_2}}(y)\right) \end{array} \right\}$$

$$X_1 \otimes X_2 = \left\{ \begin{array}{c} \left(\begin{array}{c} T_{T_{x_1}}(y) \cdot T_{T_{x_2}}(y), T_{I_{x_1}}(y) \cdot T_{I_{x_2}}(y), \\ T_{F_{x_2}}(y) \cdot T_{F_{x_2}}(y) \end{array} \right), \\ \left(\begin{array}{c} \left(I_{T_{x_1}}(y) + I_{T_{x_2}}(y) - I_{T_{x_1}}(y) \cdot I_{T_{x_2}}(y)\right), \\ \left(I_{I_{x_1}}(y) + I_{I_{x_2}}(y) - I_{I_{x_1}}(y) \cdot I_{I_{x_2}}(y)\right), \\ \left(I_{F_{x_1}}(y) + I_{F_{x_2}}(y) - I_{F_{x_1}}(y) \cdot I_{F_{x_2}}(y)\right) \end{array} \right), \\ \left(\begin{array}{c} \left(F_{T_{x_1}}(y) + F_{T_{x_2}}(y) - F_{T_{x_1}}(y) \cdot F_{T_{x_2}}(y)\right), \\ \left(F_{I_{x_1}}(y) + F_{I_{x_2}}(y) - F_{I_{x_1}}(y) \cdot F_{I_{x_2}}(y)\right), \\ \left(F_{F_{x_1}}(y) + F_{F_{x_2}}(y) - F_{F_{x_1}}(y) \cdot F_{F_{x_2}}(y)\right) \end{array} \right) \end{array} \right\}$$

$$\curlywedge X_1 = \left\{ \begin{array}{c} \left(\begin{array}{c} \left(1 - \left(1 - T_{T_{x_1}}(y)\right)^{\curlywedge}\right), \\ \left(1 - \left(1 - T_{I_{x_1}}(y)\right)^{\curlywedge}\right), \\ \left(1 - \left(1 - T_F(y)\right)^{\curlywedge}\right) \end{array} \right), \\ \left(\begin{array}{c} \left(I_{T_{x_1}}(y)\right)^{\curlywedge}, \left(I_{I_{x_1}}(y)\right)^{\curlywedge}, \\ \left(I_{F_{x_1}}(y)\right)^{\curlywedge} \end{array} \right), \\ \left(\left(F_{T_{x_1}}(y)\right)^{\curlywedge}, \left(F_{I_{x_1}}(y)\right)^{\curlywedge}, \left(F_{F_{x_1}}(y)\right)^{\curlywedge}\right) \end{array} \right\}$$

$$X_1^{\curlywedge} = \left\{ \begin{array}{c} \left(\begin{array}{c} \left(T_{T_{x_1}}(y)\right)^{\curlywedge}, \left(T_{T_{x_1}}(y)\right)^{\curlywedge}, \left(T_{T_{x_1}}(y)\right)^{\curlywedge}\right), \\ \left(\begin{array}{c} \left(1 - \left(1 - I_{T_{x_1}}(y)\right)^{\curlywedge}\right), \\ \left(1 - \left(1 - I_{I_{x_1}}(y)\right)^{\curlywedge}\right), \\ \left(1 - \left(1 - I_F(y)\right)^{\curlywedge}\right) \end{array} \right), \\ \left(\begin{array}{c} \left(1 - \left(1 - F_{T_{x_1}}(y)\right)^{\curlywedge}\right), \\ \left(1 - \left(1 - F_{I_{x_1}}(y)\right)^{\curlywedge}\right), \\ \left(1 - \left(1 - F_F(y)\right)^{\curlywedge}\right) \end{array} \right) \end{array} \right\}$$

The weighted aggregation can be computed as:

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$$T2NNWA_w = \left\{ \begin{pmatrix} 1-\prod_{p=1}^{n}\left(1-T_{T_p}(y)\right)^{w_p}, \\ 1-\prod_{p=1}^{n}\left(1-T_{I_p}(y)\right)^{w_p}, \\ 1-\prod_{p=1}^{n}\left(1-T_{I_p}(y)\right)^{w_p} \end{pmatrix}, \begin{pmatrix} \prod_{p=1}^{n}\left(I_{Ts_p}(y)\right)^{w_p}, \prod_{p=1}^{n}\left(I_{I_p}(y)\right)^{w_p}, \\ \prod_{p=1}^{n}\left(I_{F_p}(y)\right)^{w_p} \end{pmatrix}, \begin{pmatrix} \prod_{p=1}^{n}\left(F_{Ts_p}(y)\right)^{w_p}, \prod_{p=1}^{n}\left(F_{I_p}(y)\right)^{w_p}, \\ \prod_{p=1}^{n}\left(F_{F_p}(y)\right)^{w_p} \end{pmatrix} \right\}$$

$$X^{+} = \left\{ \begin{pmatrix} \max_p\left(T_{T_p}(y)\right), \max_p\left(T_{I_p}(y)\right), \\ \max_p\left(T_{F_p}(y)\right), \\ \begin{pmatrix} \min_p\left(I_{T_p}(y)\right), \min_p\left(I_{I_p}(y)\right), \\ \min_p\left(I_{F_p}(y)\right) \end{pmatrix} \\ \left(\min_p\left(F_{T_p}(y)\right), \min_p\left(F_{I_p}(y)\right), \min_p\left(F_{F_p}(y)\right)\right) \end{pmatrix} \right\}$$

$$X^{-} = \left\{ \begin{pmatrix} \begin{pmatrix} \min_p\left(T_{T_p}(y)\right), \min_p\left(T_{I_p}(y)\right), \\ \min_p\left(T_{I_p}(y)\right) \end{pmatrix}, \\ \max_p\left(I_{T_p}(y)\right), \max_p\left(I_{I_p}(y)\right), \\ \max_p\left(I_{F_p}(y)\right), \\ \max_p\left(F_{T_p}(y)\right), \max_p\left(F_{I_p}(y)\right), \\ \max_p\left(F_{F_p}(y)\right) \end{pmatrix} \right\}$$

6. Neutrosophic Representation of Turnover Intentions

In the context of crafting a Neutrosophic-Driven Tool to probe turnover propensities in manufacturing entities, we can formulate neutrosophic equations to capture the inherent complexities of the turnover phenomenon. Considering the representation of turnover intentions for a specific criterion *i* and participant *j*:

For Turnover (T): $[T_{ij}L, T_{ij}m, T_iju]$
For Indeterminacy (I): $[I_{ij}L, I_{ij}m, I_iju]$
For Indeterminacy (I): $[F_{ij}L, F_{ij}m, F_iju]$

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Here, *T* represents the degree of truth, *I* represents the degree of indeterminacy, and *F* represents the degree of falsity. The subscripts *ij* denote the specific criterion and participant, while the subscripts *L*, *M*, and *U* represent the lower, middle, and upper values of the respective degrees.

Aggregation of Neutrosophic Values:

The aggregation of these neutrosophic values for a given criterion across all participants can be represented as:

$$\text{For Turnover (T): } [T_iL, TiM, T_iu] = \left[\sum_j T_ijL\,,\ \sum_j T_{ij}M\,,\ \sum_j T_ij^U\right]$$

$$\text{For Indeterminacy (I): } [I_iL, IiM, I_iu] = \left[\sum_j I_ijL\,,\ \sum_j I_{ij}M\,,\ \sum_j I_ij^U\right]$$

$$\text{For Falsity (F): } [F_iL, FiM, F_iu] = \left[\sum_j F_ijL\,,\ \sum_j F_{ij}M\,,\ \sum_j F_ij^U\right]$$

The summation is performed across all participants *j* for each degree (truth, indeterminacy, falsity).

Normalization of Aggregated Values:

Normalize the aggregated values to obtain the final representation:

$$\text{For Turnover (T): } [T_i'L, T_i'M, T_i'U] = \frac{[T_iL, T_iM, T_iu]}{\sum k[TkL, TkM, TkU]}$$

$$\text{For Indeterminacy (I): } [I_i'L, I_i'M, I_i'U] = \frac{[I_iL, I_iM, I_iu]}{\sum k[IkL, IkM, IkU]}$$

$$\text{For Falsity (F): } [F_i'L, F_i'M, F_i'U] = \frac{[F_iL, F_iM, F_iu]}{\sum k[FkL, FkM, FkU]}$$

The denominator is the summation of normalized values for all criteria *k*.

These neutrosophic equations provide a structured representation of turnover propensities for each criterion, considering the inherent uncertainties and contradictions within the responses of different participants. The Neutrosophic-Driven Tool can utilize these equations to capture the complex nature of turnover intentions in manufacturing entities.

7. Results and discussion

Thematic analysis was done on qualitative data. Whereas data collected through the questionnaire was analyzed using Microsoft Excel 2013 AMOS 24.0, and SPSS 24.0. Details of factor analyses are described to explain the validity of the instrument.

Thematic analysis

The responses from participants were recorded in the Urdu language, and they were transcribed. Codes were generated, and assigned single code to similar responses, after analyzing the codes, themes were identified and then names were assigned to themes. Themes discussed and found in the literature were given the name using similar terms found in the literature. The following six themes were developed from the interview data.

Poor reward and benefits

Employees opined that employees leave an organization because of the low amount of salary or because other benefits are not provided to them. Employees declared themselves from lower income groups so, for them, less payment or absence/lack of benefits is very discouraging, which may cause them to leave an organization rather continuing with it.

Unfavorable Workplace Environment

Manufacturing organizations were reported to be devoid of cleanliness, they were reported to not have proper disposal of waste or unsafe material that causes employees to get sick or feel uncomfortable during work. They also expressed experiencing emissions of toxic gases and particles that create respiratory problems. Since the early 1970s, global carbon emissions have increased by 40% [27,36]. They also complain about unhygienic surroundings and lack of sanitation. While high temperatures, darkness, and lack of first aid facilities were also reported to be a cause of the intention to quit.

Unconducive Management style

Employees expressed the unfriendly, rude, and insulting behavior of bosses as a factor that causes employees to leave. Lack of empathy, guidance, and support by their heads was also attributed to turnover intention. The incompetency of

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bosses was also reported in the interview, which may create problems for employees to do work under his/her guidance. A few responses were about disliking without mentioning any reason for that.

Alternate job opportunities
The availability of other jobs was termed as an attractive factor for employees that may encourage them to leave. Being skilled and qualified was mentioned as a factor that causes expectation to find other jobs that may create turnover intention, while hope/promises by others for helping in job acquisition may also result similarly. The current jobs were also compared with the jobs in the surroundings/accessibility and termed unattractive.

Overtime unavailability
Employees express their need to work overtime, they were too desperate to get overtime work. They talked about their insufficient income, which makes them require overtime jobs, and the unavailability of overtime work in a particular organization creates turnover intention in them.

Attraction to gratuity withdrawal
Employees expressed their interest in a lump sum amount accumulated as gratuity, and due to its quality of being "huge", they opt for leaving a job rather than continuing, which can give them that accumulated amount and fulfill an unaffordable need or invest somewhere else.

Exploratory factor analysis
The questionnaire for this study was developed in the Urdu language, therefore it was crucial to perform Exploratory Factor Analysis (EFA). It is used for determining and ascertaining the factors' structure in the context of the population being studied, along with validating all scales of the instruments, Tanchi, and Shaw, Delery, and Gupta also applied EFA in a similar kind of studies. For ascertaining the structure of items measuring determinants of employee turnover intention in the context of manufacturing organizations, and validating the items' structure, Exploratory Factor analysis was performed in this study.
Four methods were used to conduct exploratory factor analysis; Kaiser-Meyer-Olkin (KMO) Measure and Bartlett Test of Sphericity, Extraction Value/Load Factor, Total Variance Explained, and Rotated Component Matrix.

KMO and Bartlett's Test of Sphericity
Bartlett's Test of Sphericity is assessed through the significance of its value which reveals that the correlation among items is greater than or equal to the required value of 0.3 and is suitable for exploratory factor analysis [33].
Table 3 exhibits the Kaiser-Meyer-Olkin (KMO) value that measures the adequacy of sampling for all scales measuring determinants of turnover intention was .908, and the Bartlett's Test of Sphericity also has significance with a p-value less than .001, which indicates the appropriation of sample data for performing factor analysis.

Table 3: KMO and Bartlett's Test Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.908
Bartlett's Test of Sphericity	Approx. Chi-Square	11597.857
	Df	496
	Sig.	.000

Source: Developed by the authors

Extraction Value / Communalities
Communalities represent the reliability of the indicator in the context of the factors being posited. It also denotes the percent of the variance in each factor supported jointly by all the factors.

Table 4: Communalities of extracted values

	Extraction	Initial
TI1	.890	1.000
TI2	.871	1.000
TI3	.908	1.000
TI4	.891	1.000
PRB1	.863	1.000

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PRB2	.865	1.000
PRB3	.812	1.000
PRB4	.869	1.000
JI1	.885	1.000
JI2	.841	1.000
JI3	.874	1.000
JI4	.857	1.000
UWE1	.872	1.000
UWE2	.850	1.000
UWE3	.881	1.000
UWE4	.848	1.000
UMS1	.903	1.000
UMS2	.888	1.000
UMS3	.908	1.000
UMS4	.898	1.000
AJO1	.857	1.000
AJO2	.866	1.000
AJO3	.891	1.000
AJO4	.353	1.000
OU1	.781	1.000
OU2	.859	1.000
OU3	.833	1.000
OU4	.400	1.000
AGW1	.855	1.000
AGW2	.785	1.000
AGW3	.763	1.000
AGW4	.821	1.000

The extraction value for all the items should be greater than 0.4. Table 4 displays an Analysis of communalities for this study, which determined the extraction value fulfilling the criteria, except AJO4 which has a loading of .353, and OU4 which has a loading of .400. Hence, the lower values signal the possible removal of the items in the next analysis. Item TI3 and UMS3 show the highest loadings of .908.

Exploratory Factors Extraction

Factors were extracted on the criteria described by Kaiser that the Eigenvalue to be greater than 1. Results of factor extraction of determinants and turnover intention are shown in Table 5. Based on Eigenvalue criteria, all eight factors emerged. A total 82.928% variance was explained by the eight factors.

Table 5: Total variance explained and factors extracted in the EFA model

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.291	41.535	41.535	13.291	41.535	41.535	3.933	12.289	12.289
2	3.150	9.844	51.379	3.150	9.844	51.379	3.672	11.474	23.763
3	2.247	7.585	58.964	2.247	7.585	58.964	3.619	11.308	35.071
4	2.049	6.403	65.367	2.049	6.403	65.357	3.578	11.180	46.251
5	1.672	5.225	70.592	1.672	5.225	70.592	3.369	10.529	56.780
6	1.514	4.731	75.323	1.514	4.731	75.323	3.026	9.455	66.235

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7	1.434	4.481	79.803	1.434	4.481	79.803	2.822	8.818	75.054
8	1.000	3.125	82.928	1.000	3.125	82.928	2.520	7.875	82.928

Source: Developed by the authors

Component Rotation Matrix

The rotated component matrix showed that all items loaded on eight factors that are consistent with the expected component structure based on which the instrument was designed. All four items of each eight factors were loaded clearly on separate factors. It is indicating that neither there are any problems in the translation of scale or characteristics of the sample nor there is any requirement for further refinement. Factor loadings ranged from .497 to .915. Items of the factor unconducive management style have the highest loadings while items of the factor turnover intention have the lowest loadings. Table 6 exhibits the results.

Table 6: Rotated Component Matrix

	Components							
	1	2	3	4	5	6	7	8
UMS1	.900							
UMS3	.894							
UMS4	.893							
UMS2	.885							
UWE3		.867						
UWE4		.862						
UWE1		.860						
UWE2		.823						
JI3			.846					
JI2			.834					
JI1			.828					
JI4			.807					
PRB4				.835				
PRB2				.819				
PRB1				.814				
PRB3				.799				
AGW1					.915			
AGW4					.869			
AGW2					.849			
AGW3					.838			
AJO1						.832		
AJO2						.830		
AJO3						.826		
AJO4						.497		
OU2							.856	
OU3							.821	
OU1							.787	
OU4							.570	
TI3								.733
TI4								.729
TI1								.662
TI2								.652

Source: Developed by the authors

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This study reports the results of the development and validation of scales of Determinants of turnover intention in the Urdu language. For confirming the dimensionality and original structure of all the factors in the instrument, Exploratory Factor analysis was performed. For extracting the factors Principal component analysis factoring method was employed. Whereas Varimax with Kaiser Normalization was applied for item rotation. In Exploratory Factor Analysis, all the factors developed to measure a particular construct were extracted with the same construct.

Confirmatory factor analysis

The scales examined in exploratory factor analysis also underwent Confirmatory Factor Analysis (CFA). After the development of instruments using EFA and other techniques, they are subject to confirmatory factor analysis [21].

The Measurement Model for Determinants of Employee Turnover Intention

For ascertaining the validity of the model, the measurement model was structured on AMOS 20 version and run for exploring the fitness indexes. Figure 1 is showing the model. The Fitness Indexes obtained for the measurement model were examined. CMIN/ DF = 2.781 with a significant p-value, Values of AGFI= 0.779, GFI = 0.818, TLI = 0. 923, CFI = 0.933, NFI = 0.899 and RMSEA = 0.072. Except for values of CMIN/DF, TLI, CFI, and NFI, other values do not show an excellent fit. The factor loading for every item was examined. Two items AJO4 and OU4 have factor loadings of 0.388 and 0.384 respectively. Fornell suggested .70 as a cutoff value for factor loading, whereas Hair described .50 as the cutoff value for factor loading of an item [24,31].

The factor loadings of AJO4 and OU4 are even less than the suggested value of Hair [31]. Since these items are considered problematic in the model. Needs deletion from the measurement model. Items with low factor loading were reviewed. Item AJO4 reads as "If I leave this job, I will find another job easily" pertains to the construct "Alternate Job Opportunities". Since this item is a conditional sentence, other items measuring the same construct are not conditional sentences, e.g. "There are various job opportunities in the market", "Other jobs are better than this job", and "Other job opportunities make me leave this job". Hence, the item AJO4 appeared to be odd, and consequently was deleted from the measurement model.

Item OU4 reads as "Overtime work will be a great contribution to my livelihood" pertains to the construct "Overtime Unavailability". Since, this item describes the significance of overtime availability in terms of its positive effect on one's livelihood, which is somehow more than just evaluating the significance of Overtime work. The other items measuring the same construct do not describe the effect of overtime work, just measure its unavailability and significance, e.g. "I don't have overtime work here", "I definitely need a job with overtime facility", and "My organization should provide me overtime work". Hence the item OU4 appeared to be odd, and consequently was deleted from the measurement model.

After the deletion of items having low factor loadings, the measurement model was again run on AMOS. The required fitness indexes could not be obtained after the deletion of items with low factor loading. For further improvement of the model and achieving fitness indexes Modification Indices (MI) were identified. MI of approximately 4.0 or greater denotes that the fit could be improved [32]. Therefore, modification indices items with a high value of modification indices — which are considered redundant items in the model — were correlated to achieve the fitness indices. Table 7 presents the model fitness indices of the modified measurement model.

Table 7: Model Fitness Indexes for modified measurement model – Determinants of turnover intention (n=342)

Factors	***Values***	***Factors***	***Values***
CMIN/DF	1.787	P-Value	0.000
AGFI	0.857	GFI	0.887
NFI	0.944	TLI	0.970
CFI	0.975	RMSEA	0.048

Source: Developed by the authors

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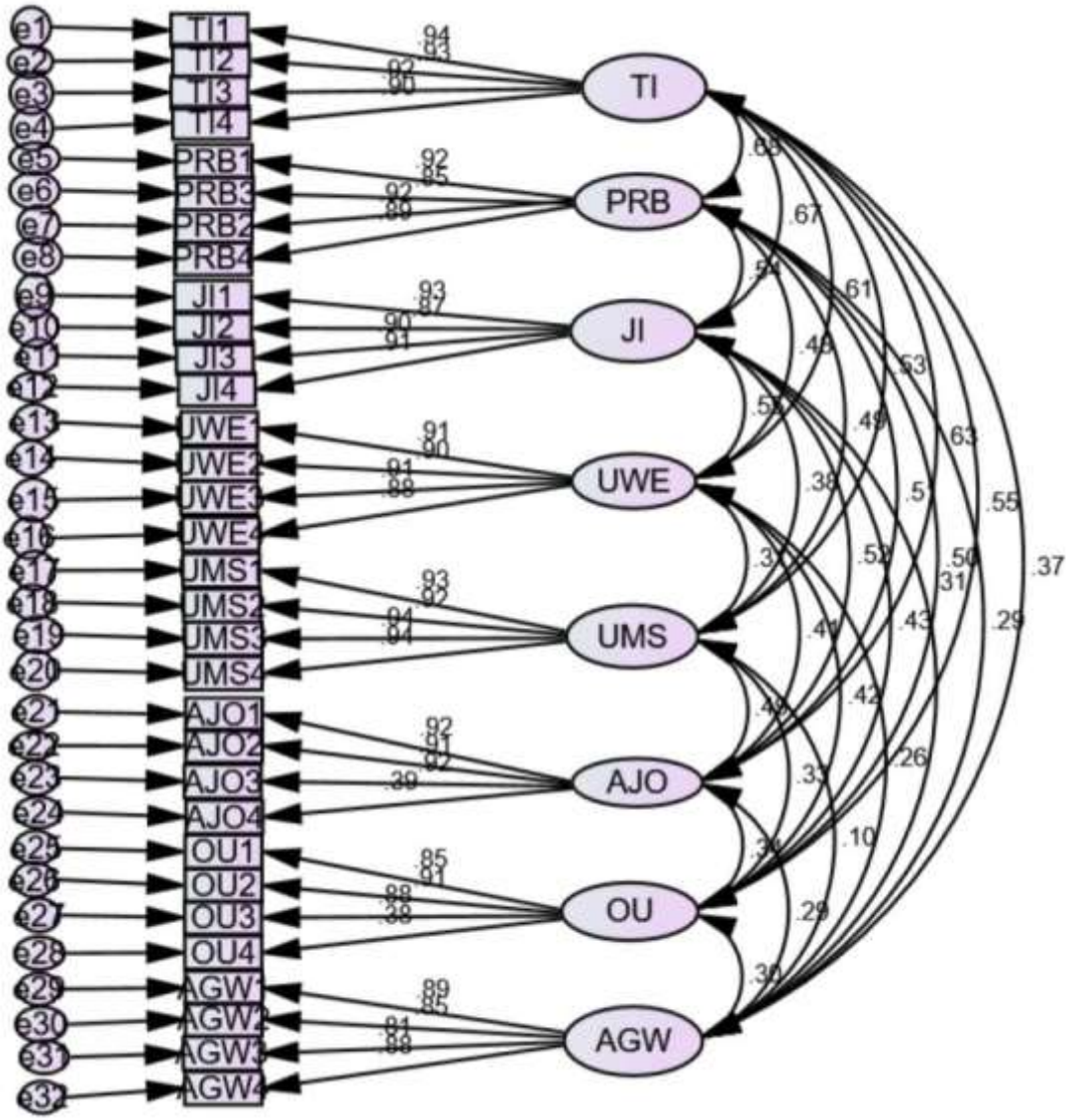

Figure 1: Measurement Model for Determinants of Employee Turnover Intention

After constraining the ten redundant items from 32 items, there is an improvement in fitness indexes. The excellent fit is indicated by the fit indexes of the improved measurement model with CMIN/DF =1.787 having P-Value = 0.000, along with AGFI = 0.875 GFI = 0.887, NFI = 0. 944, TLI = 0. 970, CFI = 0.975, and RMSEA = 0. 048. All indexes achieved excellent/best-fit values, except AGFI and GFI, which are below the excellent/best-fit values. AGFI has achieved a reasonably acceptable level of≥ 0.80 whereas GFI is very closer to its reasonably acceptable level of≥ 0.90 described by. Bentler and Bonett recommended a CFI cutoff of .90 but this model has achieved the cutoff of .95 recommended by Hu and Bentler [14,36].

Convergent Validity of Measurement Model

For evaluating the convergent validity, all the items were evaluated based on their factor loadings. Subsequently, Composite Reliability (CR) was calculated for ascertaining the internal consistency among the items measuring the same construct, while Average Variance Extracted (AVE) was also computed to knowing how stronger the variance taken by the construct about the variance because of the measurement error as prescribed by Chang, Wang, & Yang [19]. Table 8 exhibits the results.

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Table 8: Factor loading, CR, and AVE for determinants of turnover intention (n=342)

Constructs	Items	Factor loading (Above 0.7)	CR (Above 0.7)	AVE (Above 0.5)
TI	TI1	.947	0.952	0.832
	TI2	.934		
	TI3	.892		
	TI4	.873		
PRB	PRB1	.947	0.940	0.797
	PRB2	.924		
	PRB3	.836		
	PRB4	.859		
JI	JI1	.910	0.952	0.833
	J12	.909		
	J13	.895		
	J14	.937		
UWE	UWE1	.929	0.939	0.794
	UWE2	.920		
	UWE3	.877		
	UWE4	.836		
UMS	UMS1	.909	0.963	0.868
	UMS2	.915		
	UMS3	.964		
	UMS4	.938		
AJO	AJO1	.923	0.940	0.838
	AJO2	.906		
	AJO3	.918		
	AJO4	Deleted		
OU	OU1	.854	0.913	0.779
	OU2	.913		
	OU3	.879		
	OU4	Deleted		
AGW	AGW1	.832	0.916	0.733
	AGW2	.841		
	AGW3	.804		
	AGW4	.941		

Source: Developed by the authors

This measurement model achieved convergent validity, because all items measuring one construct converge or come on the same point, which is supported by obtaining the required values of Average Variance Extracted above 0.5, whereas values of Composite Reliability above 0.7. On the other hand, for achieving construct validity all items of a construct should have the required value of factor loading > 0.7. Except for two items — one item measuring alternate job opportunity and another item measuring overtime unavailability — all items were having the required value of factor loading; therefore the two items were deleted from the measurement model to achieve convergent validity.

Discriminate validity of measurement model

For identifying discriminant validity, the criterion was used, it was examined whether each construct has a square root value of AVE higher than the correlations between it and any other constructs in the model or not. Each cell of Table 9 denotes the correlation between the construct listed horizontally and the construct listed vertically. The values given diagonally (in bold) are the square root of the construct's AVE.

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Table 9: Discriminate validity of measurement model (n=342)

	OU	TI	PRB	JI	UWE	UMS	AJO	AGW
OU	0.882							
TI	0.550	0.912						
PRB	0.500	0.679	0.893					
JI	0.424	0.669	0.511	0.913				
UWE	0.431	0.612	0.473	0.549	0.891			
UMS	0.336	0.536	0.500	0.366	0.303	0.932		
AJO	0.341	0.638	0.503	0.487	0.402	0.480	0.916	
AGW	0.319	0.391	0.306	0.312	0.282	0.109	0.309	0.856

Source: Developed by the authors

If a value highlighted diagonally (square root) is higher than the other values in its column and row, indicates the discriminant validity for all constructs, which is exhibited in Table 9. So, it is established that all the eight constructs identified as determinants have discriminant validity. Having discriminant validity denotes that items measuring the constructs in this measurement model are not overlapping and items of one construct are specifically measuring that construct, not the others.

8. Theoretical contribution and managerial implications

The study demonstrates the reliability and validity of the instrument (Urdu version) measuring determinants of the turnover intention of non-executive employees in the Pakistani context. As non-executive employees usually cannot comprehend the English language adequately. This instrument can be used for measuring employee turnover intention in a country having Urdu or a similar language e.g., Hindi as the native language of their employees. The questionnaire developed and validated in this study is based on self–rated responses about turnover intention and the factors that determine turnover intention. The instrument may help researchers in empirical studies while measuring employee turnover intention and its determinants, particularly in manufacturing organizations.

Since this study has developed and validated the items that are measuring the constructs typical to manufacturing organizations i.e., overtime unavailability and attraction to gratuity withdrawal. These two items are not studied earlier in the literature about turnover intention., thus this study introduced these new variables into the relevant literature.

This questionnaire was developed for measuring responses in manufacturing organizations, the factors identified through the theme of qualitative study i.e. interview, factors identified in the study are typically found in manufacturing organizations, but they are not limited to manufacturing organizations, the instrument can be used for any other industry/sectors too.

Employee turnover is a thorny issue for organizations and the country at large. The ordeals of such segments of society need to be identified and dealt with adequate corrective actions, and for that, this instrument will serve as an effective tool. The exit of employees doesn't only hamper the smooth functioning of organizations but also incurs the cost of fulfilling the vacancy. Hence, before its occurrence, if employees' intention to leave and their reason are brought on board, the turnover can be restrained, and this instrument can play a crucial role in this regard.

9. Conclusion and areas for future research

For this study instrument was developed from the factors identified in the literature and most of them were also identified from the themes developed through interviews. Eventually, the results endorse that except for two items, all the items of the instrument that are measuring determinants of turnover intention exhibit good convergent validity and discriminant validity, hence revealing good construct validity.

The study has some limitations. Since it was conducted in Pakistan, there is no healthy research culture, and inquiry for research is deemed as a threat to employees, so researchers encounter reluctance and defensiveness from respondents. The instrument developed and validated in this study may be tested on other populations, that have favorable attitudes toward research.

There is a limitation in terms of factors/variables it worked on. The eight variables identified as determinants were only extrinsic factors, while intrinsic factors were not analyzed as determinants of turnover intention. In the future, an instrument containing intrinsic factors as causes of employee turnover intention can be developed or validated.

Data availability statement

The datasets presented in this article are not readily available because the data contains personal information that cannot be easily anonymized. The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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