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Development of the Technology Transfer Office Satisfaction Scale: Preliminary Validity and Reliability Findings*

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ABSTRACT: *This study examined the preliminary validity and reliability findings of the Technology Transfer Office Satisfaction Scale, developed to measure stakeholder satisfaction with Technology Transfer Office (TTO) services at Turkish universities. Using a quantitative preliminary scale-development design, the item pool was created from the literature on TTO services, stakeholder satisfaction, service quality, and university-industry collaboration. The items were evaluated by 12 experts, the revised form was piloted with 30 participants, and an initial 30-item form was prepared. The main application was conducted with 101 stakeholders who had experience interacting with TTO services. Data were analyzed through item-total correlations, principal component analysis, preliminary confirmatory factor analysis on the same dataset, Cronbach's alpha, and McDonald's omega. The analyses yielded a 24-item, two-component preliminary structure named "Institutional Capacity and Strategic Impact" and "Operational Services and Communication." The structure explained 71.11% of the total variance; alpha was .977 and omega was .978 for the overall scale. The findings provided preliminary psychometric evidence of the scale's potential to measure stakeholder satisfaction and indicated that it should be retested with larger and independent samples.*

KEYWORDS - *preliminary validity, reliability, scale development, stakeholder satisfaction, Technology Transfer Office*

I. INTRODUCTION

With the strengthening of the knowledge economy, universities' research, education, and social contribution functions have evolved into a more interactive and output-oriented structure. Within this transformation, universities are regarded as institutional actors responsible not only for producing scientific knowledge but also for converting that knowledge into economic, technological, and social benefit. Theoretical frameworks such as the entrepreneurial university, the third mission, and the triple helix approach emphasize that universities' relationships with industry, government, and society are decisive for institutional capacity and the innovation ecosystem [1–3].

In this context, Technology Transfer Offices (TTOs) are among the principal interface structures involved in transferring knowledge produced at universities into practice, commercializing research results,

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managing intellectual property processes, supporting patenting and licensing activities, developing entrepreneurial capacity, and conducting university-industry collaboration processes. TTOs mediate between academic knowledge and fields of application and support information flow, process coordination, and collaboration mechanisms among researchers, entrepreneurs, industry representatives, investors, and university administrations [4–6].

In the literature, TTO performance is generally evaluated through patent applications, licensing agreements, industry income, the number of supported projects, entrepreneurial outputs, spin-off formation, and commercialization indicators [7–9]. These indicators are important because they make the tangible and comparable outputs of technology transfer activities visible. However, output-based indicators do not directly explain how stakeholders experience service processes, how easily services can be accessed, how the guidance and communication capacity of TTO staff is perceived, or the extent to which stakeholders are satisfied with TTO services.

Technology transfer processes are complex and require the management of uncertainty, expertise, multi-actor interaction, and long-term relationships. Therefore, the quality of TTO services is associated with stakeholders' service experiences as well as measurable outputs. Stakeholder satisfaction enables the quality of TTO services to be evaluated through dimensions such as accessibility, communication, information provision, trust, consultancy, process facilitation, perceived contribution, and institutional support. In this respect, stakeholder satisfaction offers a service-oriented measurement domain that complements output indicators in the evaluation of TTO performance.

Although numerous studies have addressed TTO performance, standardized measurement instruments that focus directly on stakeholder satisfaction with TTO services appear to be limited. In service quality and satisfaction research, developing valid and reliable measurement instruments is important for defining the theoretical boundaries of the construct under investigation, identifying strengths and areas requiring improvement in service processes, and supporting institutional improvement decisions with evidence. This need calls for the development of a measurement instrument capable of assessing stakeholder satisfaction with TTO services multidimensionally.

The purpose of this study is to examine the preliminary validity and reliability findings of the TTO Satisfaction Scale developed to measure stakeholder satisfaction with TTO services. For this purpose, the scale items were developed on the basis of the literature and refined through expert review and pilot implementation; item analysis, principal component analysis, preliminary confirmatory factor analysis, and internal consistency analyses were then conducted using the main-application data. Rather than providing a final validation of the scale, the study aims to present preliminary psychometric evidence for a two-dimensional candidate instrument suitable for measuring stakeholder satisfaction with TTO services.

II. METHOD

2.1 Research Design

This study is a quantitative preliminary scale-development study examining the preliminary validity and reliability findings of the TTO Satisfaction Scale developed to measure stakeholder satisfaction with TTO services. The study comprised the development of an item pool, expert-based content evaluation, pilot implementation, main implementation, item analysis, principal component analysis, preliminary confirmatory factor analysis on the same dataset, and internal consistency analyses [10–12]. The study seeks to provide initial psychometric evidence for a candidate instrument suitable for measuring stakeholder satisfaction with TTO services rather than to establish the final psychometric validation of the scale. Accordingly, the confirmatory factor analysis findings were evaluated not as final validation evidence obtained from an independent sample, but as a preliminary examination of the model-data fit of the measurement structure derived through principal component analysis.

2.2 Development of the Item Pool

The item-development process considered the literature on the principal service areas of TTOs, stakeholder satisfaction, service quality, university-industry collaboration, technology transfer, intellectual property management, patenting, licensing, entrepreneurship, commercialization, project development, and institutional contribution. Within this framework, satisfaction with TTO services was assumed to be associated with accessibility, communication, information provision, guidance, trust, process facilitation, consultancy, project support, intellectual property support, commercialization support, collaboration capacity, and perceived institutional contribution. In constructing the item pool, care was taken to ensure that each item expressed a single judgment, was comprehensible to the target population, used positive and clear wording, could be associated with the TTO service experience, and represented the construct of stakeholder satisfaction. Statements that were overly general, ambiguous, contained multiple judgments, or addressed a particular stakeholder group too narrowly were reviewed. At the end of this process, the initial item pool was prepared for expert evaluation.

2.3 Expert-Based Content Evaluation

The prepared item pool was submitted to 12 academics with expertise in technology transfer, university-industry collaboration, measurement and evaluation, educational administration, and entrepreneurship for evaluation in terms of content relevance and wording quality. All experts held doctoral degrees and had at least 10 years of academic and/or practical experience in the relevant fields. The expert group included academics with managerial or consultancy experience in TTOs as well as researchers working in scale development and psychometrics. The experts were asked to examine the items in terms of their degree of representation of the target construct, content relevance, clarity of wording, suitability for stakeholder groups, answerability, and relationship with TTO service areas.

In this study, expert evaluation was used as a qualitative content assessment and item-improvement process rather than to calculate a quantitative content-validity coefficient. In line with expert opinions, items with similar content were combined, items considered outside the scope or weakly related to the target construct were removed, and items with ambiguous wording were rewritten. In addition, statements that could be difficult for all stakeholder groups to answer were converted into a more general, clear, and experience-based form. Following these revisions, the pilot form of the scale was prepared.

2.4 Pilot Implementation

The form revised in line with expert opinions was piloted with 30 participants before the main implementation. The purpose of the pilot was not to test the psychometric structure, but to evaluate item comprehensibility, the suitability of the response options, administration time, clarity of the instructions, and possible difficulties participants might encounter while responding to the items. Based on the feedback obtained from the pilot, linguistic and formal revisions were made to certain items. Statements that reduced comprehensibility were simplified, items with similar meanings were reviewed, and the scale instructions were clarified. This process resulted in an initial 30-item form using a five-point Likert format. The response options ranged from “1 = Strongly Disagree” to “5 = Strongly Agree.”

2.5 Study Group

The main-implementation study group consisted of 101 participants who had experience interacting with TTO services. Inclusion criteria were having used TTO services, having had direct or indirect contact with TTO processes, and possessing sufficient experience to evaluate TTO services. The participants' varying levels of experience with TTO services enabled the scale items to be examined preliminarily through different stakeholder perceptions. Nevertheless, the sample size was considered limited for the final psychometric validation of the scale.

2.6 Data Collection Process

Following ethics committee approval, the quantitative data were collected between August 12, 2025, and October 11, 2025, using the TTO Satisfaction Scale developed to measure stakeholder satisfaction with TTO services. Before the survey was administered, participants were informed about the purpose and scope of the study, the principles of voluntary participation, and confidentiality and anonymity. Informed consent was obtained from the participants, and no personally identifying data were collected.

The data-collection instrument consisted of two sections. The first section collected information on participants' gender, age range, academic title, primary field of work or research, duration of using TTO services, and number of projects conducted with TTO support during the previous three years. The second section contained the initial 30-item form prepared to measure stakeholder satisfaction with TTO services.

The scale items were structured in a five-point Likert format. Participants were asked to rate their opinions on each item from "1 = Strongly Disagree" to "5 = Strongly Agree." A high score on the scale indicates a high level of perceived satisfaction with TTO services.

2.7 Data Analysis

At the first stage of data analysis, the dataset was checked and missing or erroneous data were examined. Item-total correlations were calculated to determine the relationship between the scale items and the total score. Values of .30 and above were accepted as the criterion for acceptable item-total correlations [10].

Principal component analysis was conducted to examine the factor structure of the scale. Principal component analysis was used as the extraction method and orthogonal Varimax rotation as the rotation method. Before the analysis, the suitability of the dataset for factor analysis was evaluated using the Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity. The lower threshold for component loadings was set at .50. In evaluating cross-loading items, both the degree of separation between component loadings and the theoretical content fit of the item were considered. This process yielded a preliminary two-component structure comprising 24 items.

The two-component structure obtained through principal component analysis was tested preliminarily by confirmatory factor analysis conducted on the same dataset. The χ^2/df, RMSEA, SRMR, CFI, TLI, NFI, and IFI fit indices were considered in the confirmatory factor analysis [13]. Because the principal component analysis and confirmatory factor analysis were conducted on the same sample, the confirmatory factor analysis findings were not treated as final validation evidence, but were interpreted as preliminary psychometric support for model-data fit.

Cronbach's alpha and McDonald's omega coefficients were calculated to examine the reliability of the scale [14, 15]. Reliability coefficients were reported for the overall scale and its subdimensions. Before examining whether scale scores differed across sociodemographic variables, the assumption of normality was evaluated using the Kolmogorov-Smirnov test. Because the normality assumption was not met, the Mann-Whitney U test was used for two-group comparisons and the Kruskal-Wallis H test for variables with more than two groups.

2.8 Ethical Approval

The research process was conducted in accordance with ethical principles. Ethics committee approval for the study was obtained from the Istanbul Medipol University Social Sciences Scientific Research Ethics Committee by decision dated August 11, 2025, and numbered E-43037191-604.01-64134.

2.9 Limitations of the Study

Information on the TTOs from which participants received services and the provinces in which those offices were located was not recorded during data collection. Therefore, the satisfaction findings could not be evaluated on the basis of specific TTOs or regional distributions, and comparisons among different TTOs could not be made. In addition, the study is limited to data obtained from 101 voluntary participants. Future research should establish larger and more diverse samples from different universities, regions, and TTOs and collect information on the TTOs from which participants receive services and the geographical distribution of those

TTOs. This approach would contribute to testing the validity and reliability of the scale in different institutional contexts and to conducting comparative evaluations among TTOs.

III. FINDINGS

3.1 Participant Profile

The study included 101 participants who had experience interacting with TTO services. The distributions of participants' sociodemographic characteristics and their use of TTO services are presented in Table 1.

Table 1. Sociodemographic Characteristics of the Participants.

Variable	Category	n	%
Gender	Male	46	45.5
	Female	55	54.5
	Total	101	100.0
Age group	20-30	22	21.8
	31-40	48	47.5
	41-50	16	15.8
	51-60	9	8.9
	61 and older	6	5.9
	Total	101	100.0
Academic title	Research Assistant	7	6.9
	Other (student, administrative staff, etc.)	48	47.5
	Associate Professor	14	13.9
	Assistant Professor	23	22.8
	Professor	9	8.9
	Total	101	100.0
Primary field of work/research	Other	10	9.9
	Natural Sciences	7	6.9
	Engineering and Technology	37	36.6
	Health Sciences	26	25.7
	Social Sciences and Humanities	21	20.8
	Total	101	100.0
Duration of using TTO services	Less than 1 year	21	20.8
	1–3 years	27	26.7
	4–6 years	13	12.9
	More than 6 years	40	39.6
	Total	101	100.0
Number of projects conducted with TTO support in the previous 3 years	None	29	28.7
	1–2 projects	43	42.6
	3–5 projects	16	15.8

Variable	Category	n	%
	6–10 projects	2	2.0
	More than 10 projects	11	10.9
	Total	101	100.0

As shown in Table 1, 54.5% of the participants were women and 45.5% were men. The largest age group was 31-40 years (47.5%), followed by 20-30 years (21.8%), 41-50 years (15.8%), 51-60 years (8.9%), and 61 years and older (5.9%).

For academic title, the largest group was the "Other" category (47.5%), which included students, administrative personnel, and similar participants. Among academic titles, assistant professors had the highest representation (22.8%), followed by associate professors (13.9%), professors (8.9%), and research assistants (6.9%).

Examination of participants' primary fields of work or research showed that Engineering and Technology had the highest representation (36.6%). Health Sciences (25.7%) and Social Sciences and Humanities (20.8%) were also substantially represented in the study group. Participants in Natural Sciences accounted for 6.9%, while those in Other fields accounted for 9.9%.

Regarding the duration of using TTO services, 39.6% of the participants had more than six years of experience. This group was followed by participants with one to three years of experience (26.7%), less than one year of experience (20.8%), and four to six years of experience (12.9%). For the number of projects conducted with TTO support during the previous three years, the highest proportion was among participants reporting experience with one or two projects (42.6%). A total of 28.7% of participants reported that they had not conducted a project with TTO support during the previous three years. This distribution shows that the study group consisted of stakeholders who had interacted with TTO services for different durations and at varying levels of intensity.

3.2 Item Analysis

Item-total correlations were calculated for the 30 items in the initial application form of the TTO Satisfaction Scale. This analysis was conducted to examine the relationship of each item with the total scale score and to evaluate preliminarily the contribution of the items to the construct intended to be measured. Values of .30 and above were considered the acceptable lower threshold for item-total correlations.

Table 2. Item Analysis Results

Item	Item–Total Correlation
The TTO provides sufficient support for developing my project proposals.	0.776
I can easily access the services offered by the TTO.	0.747
TTO staff respond to my questions quickly and satisfactorily.	0.739
The training and information activities organized by the TTO meet my needs.	0.774
The TTO adequately informs me about national and international funding sources.	0.785
The support provided by the TTO in patent application processes is effective and sufficient.	0.778
The TTO guides me correctly regarding my intellectual property rights.	0.798
The TTO's efforts to establish collaboration with industry are successful.	0.783
The TTO provides sufficient guidance for the commercialization of my projects.	0.743
The TTO's communication channels are effective and accessible.	0.726
The TTO facilitates the bureaucratic procedures in my project applications.	0.725
The consultancy services offered by the TTO add value to my academic work.	0.819

Item	Item–Total Correlation
The TTO motivates me to transform my innovative ideas into projects.	0.767
The seminars and workshops organized by the TTO are current and useful.	0.791
The TTO plays an active role in university-industry collaboration projects.	0.829
Overall, I am satisfied with the TTO's services.	0.881
The TTO provides effective support in securing financing for my projects.	0.809
The TTO's expertise in patenting and licensing processes inspires confidence.	0.855
The TTO creates an environment that encourages collaboration among academics.	0.834
The TTO's services contribute to our university's ranking in national/international indices.	0.814
The TTO demonstrates a professional approach to project management.	0.874
The services offered by the TTO contribute positively to my academic career.	0.875
The TTO provides sufficient technical infrastructure support for innovative projects.	0.834
The TTO's efforts to maintain regular communication with academics are sufficient.	0.777
The TTO is effective in helping my projects reach national and international networks.	0.871
The TTO's services are consistent with the vision of a contemporary university.	0.900
The TTO has a structure that supports a culture of entrepreneurship and innovation.	0.869
The feedback provided by the TTO helps me improve my projects.	0.881
The TTO manages a transparent process for the protection and commercialization of intellectual property.	0.781
The TTO's services are effective in increasing the societal impact of my academic work.	0.856

As shown in Table 2, the item-total correlation coefficients ranged from .725 to .900. The fact that all items exceeded the .30 threshold indicates that the items in the initial application form were sufficiently associated with the total scale score.

The lowest item-total correlations were obtained for the items "The TTO facilitates the bureaucratic procedures in my project applications" (r = .725) and "The TTO's communication channels are effective and accessible" (r = .726). Because these values were above the acceptable lower threshold, no item removal was required at the item-analysis stage. The highest item-total correlations were calculated for "The TTO's services are consistent with the vision of a contemporary university" (r = .900), "Overall, I am satisfied with the TTO's services" (r = .881), and "The feedback provided by the TTO helps me improve my projects" (r = .881).

The concentration of item-total correlations in a high range indicates that the items were strongly associated with the overall satisfaction score for TTO services. However, this finding was not considered sufficient evidence by itself for content validity or the factor structure. Therefore, principal component analysis was conducted after item analysis to examine the component structure of the scale. No items were removed at the item-analysis stage; the decision to remove items was made during factor analysis by jointly considering cross-loadings and theoretical content fit.

3.3 Construct Validity Analyses

Principal component analysis was conducted to examine the component structure of the TTO Satisfaction Scale, and the resulting two-factor measurement structure was tested preliminarily through confirmatory factor analysis performed on the same dataset. Because principal component analysis and confirmatory factor analysis were conducted on the same sample, the findings presented in this section were treated not as final validation evidence but as preliminary psychometric evidence concerning the component structure of the scale.

3.3.1 Principal Component Analysis

Before principal component analysis, the suitability of the dataset for factor analysis was examined using the KMO measure of sampling adequacy and Bartlett's test of sphericity. The KMO value was .937, and Bartlett's test of sphericity was significant [$\chi^2(435) = 3671.108$, $p < .001$]. These findings indicate that the inter-item correlation structure was suitable for factor analysis.

Table 3. Results of the KMO Measure and Bartlett's Test of Sphericity.

Test	Value
KMO measure of sampling adequacy	0.937
Bartlett's test of sphericity χ^2	3671.108
df	435
p	< 0.001

At the item-analysis stage, all 30 items showed acceptable item-total correlations. During principal component analysis, component loadings, cross-loading status, and theoretical content fit were evaluated jointly. As a result of this evaluation, six items were excluded from the analysis and the component structure was formed with 24 items. The lower threshold for component loadings was accepted as .50.

Table 4. Items Excluded from the Final Form During Principal Component Analysis.

Item No.	Item
M5	The TTO adequately informs me about national and international funding sources.
M16	Overall, I am satisfied with the TTO's services.
M21	The TTO demonstrates a professional approach to project management.
M22	The services offered by the TTO contribute positively to my academic career.
M23	The TTO provides sufficient technical infrastructure support for innovative projects.
M30	The TTO's services are effective in increasing the societal impact of my academic work.

As shown in Table 4, six items in the initial 30-item application form were excluded from the final form during principal component analysis. Item-total correlation was not used as the sole criterion for item removal; component loadings, cross-loading status, separation between components, and the item's fit with the theoretical content were evaluated jointly. As a result, the scale was reduced to a preliminary two-component structure comprising 24 items.

Principal component analysis yielded a preliminary two-component structure. This structure explained 71.11% of the total variance. The first component explained 39.44% of the total variance and the second component explained 31.66%. Rotated component loadings ranged from .614 to .825.

Table 5. Rotated Component Matrix from Principal Component Analysis.

Item	Component 1	Component 2
The TTO's efforts to establish collaboration with industry are successful.	0.825	
The TTO has a structure that supports a culture of entrepreneurship and innovation.	0.815	
The TTO plays an active role in university-industry collaboration projects.	0.782	
The TTO's services are consistent with the vision of a contemporary university.	0.766	
The TTO's expertise in patenting and licensing processes inspires confidence.	0.762	

Item	Component 1	Component 2
The TTO is effective in helping my projects reach national and international networks.	0.755	
The TTO provides sufficient guidance for the commercialization of my projects.	0.751	
The TTO manages a transparent process for the protection and commercialization of intellectual property.	0.722	
The TTO guides me correctly regarding my intellectual property rights.	0.711	
The TTO's services contribute to our university's ranking in national/international indices.	0.697	
The support provided by the TTO in patent application processes is effective and sufficient.	0.696	
The TTO provides sufficient support for developing my project proposals.	0.685	
The TTO creates an environment that encourages collaboration among academics.	0.662	
The TTO provides effective support in securing financing for my projects.	0.655	
The TTO's efforts to maintain regular communication with academics are sufficient.	0.614	
The TTO's communication channels are effective and accessible.		0.777
The TTO motivates me to transform my innovative ideas into projects.		0.775
I can easily access the services offered by the TTO.		0.750
The seminars and workshops organized by the TTO are current and useful.		0.747
The consultancy services offered by the TTO add value to my academic work.		0.733
TTO staff respond to my questions quickly and satisfactorily.		0.731
The feedback provided by the TTO helps me improve my projects.		0.726
The TTO facilitates the bureaucratic procedures in my project applications.		0.719
The training and information activities organized by the TTO meet my needs.		0.644

According to Table 5, the first component consists of items concerning the TTO's perceived contributions to establishing industry collaboration, supporting an entrepreneurship and innovation culture, providing expertise in patenting and licensing processes, managing intellectual property processes, offering commercialization guidance, securing financing, and facilitating access to national and international networks. On the basis of this content structure, the first component was named "Institutional Capacity and Strategic Impact."

The second component comprises items concerning the service experience in relation to accessibility of TTO services, effectiveness of communication channels, rapid and satisfactory responses, training and information activities, consultancy services, feedback provision, facilitation of bureaucratic processes, and transformation of innovative ideas into projects. In line with this content structure, the second component was named "Operational Services and Communication."

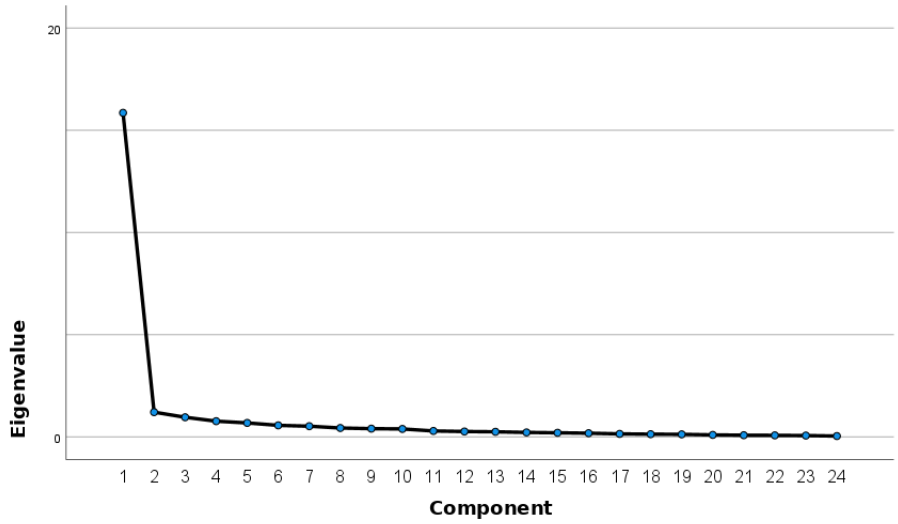


Figure 1. Scree Plot for the Principal Component Analysis.

When the scree plot and rotated component matrix are evaluated together, the scale appears to display a two-dimensional and theoretically interpretable preliminary structure. The first dimension focuses on the TTO's functions in generating institutional capacity and strategic impact, whereas the second focuses on operational service and communication processes directly experienced by stakeholders.

3.3.2 Confirmatory Factor Analysis

The preliminary 24-item, two-component structure obtained through principal component analysis was tested by confirmatory factor analysis on the same dataset. Two latent variables—"Institutional Capacity and Strategic Impact" and "Operational Services and Communication"—were defined in the model. Because this analysis was not conducted on an independent sample, it was regarded not as final validation evidence but as a preliminary examination of the model-data fit of the component structure obtained through principal component analysis.

To examine model fit, the χ^2/df, GFI, AGFI, CFI, NFI, IFI, TLI, SRMR, and RMSEA indices were evaluated. After the initial model results were examined, covariances were specified between the error terms of certain item pairs that loaded on the same factor and showed content similarity in order to improve model fit. This procedure was performed by jointly considering modification indices and item content.

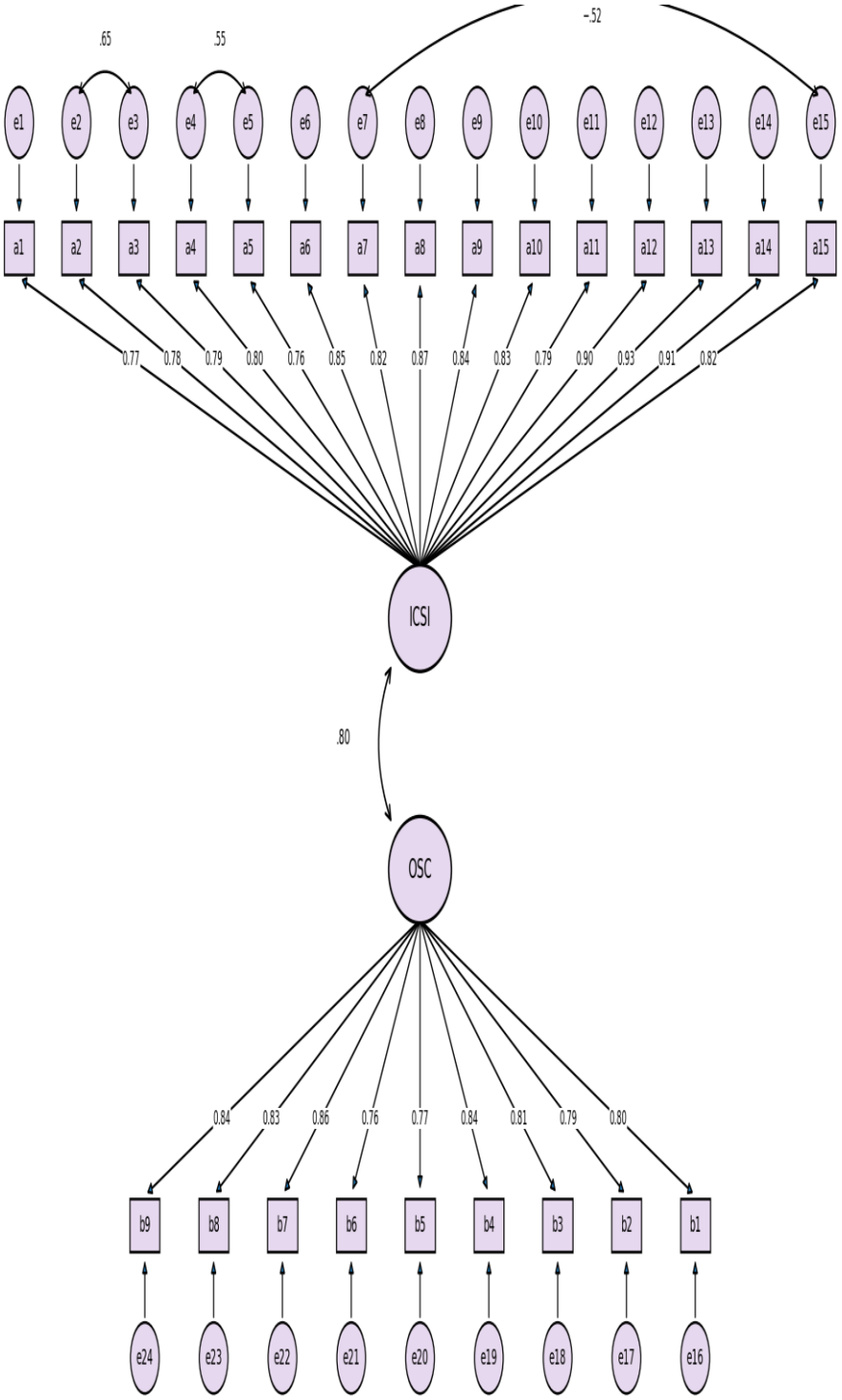


Figure 2. Confirmatory Factor Analysis Measurement Model for the TTO Satisfaction Scale.

The goodness-of-fit values obtained from the confirmatory factor analysis are presented in Table 6.

Table 6. Model Goodness-of-Fit Indices for the Confirmatory Factor Analysis

Fit index	Value
χ^2/df	2.247
GFI	0.802
AGFI	0.798
CFI	0.885
NFI	0.812
IFI	0.886
TLI	0.872
SRMR	0.044
RMSEA	0.076

Table 6 shows that the χ^2/df value was 2.247, indicating an acceptable level of model-data fit. Among the error-based fit indices, SRMR was .044 and RMSEA was .076. The SRMR value indicates good fit, while the RMSEA value indicates acceptable fit. Examination of the relative fit indices yielded CFI = .885, NFI = .812, IFI = .886, and TLI = .872. Although these values do not indicate strong or excellent fit, they suggest a preliminary and improvable level of model-data fit for the two-factor measurement structure.

Standardized and unstandardized parameter estimates for the model were examined within the confirmatory factor analysis. The findings are presented in Table 7.

Table 7. Confirmatory Factor Analysis Parameter Estimates.

Item	Factor	β	B	SE	CR	p
a1	ICSI	0.768	1.000			< 0.001
a2	ICSI	0.778	0.967	0.114	8.502	< 0.001
a3	ICSI	0.789	0.968	0.112	8.652	< 0.001
a4	ICSI	0.804	1.194	0.135	8.854	< 0.001
a5	ICSI	0.760	1.215	0.147	8.271	< 0.001
a6	ICSI	0.853	1.255	0.131	9.546	< 0.001
a7	ICSI	0.817	1.230	0.136	9.026	< 0.001
a8	ICSI	0.872	1.230	0.125	9.826	< 0.001
a9	ICSI	0.837	1.126	0.121	9.315	< 0.001
a10	ICSI	0.828	1.104	0.120	9.185	< 0.001
a11	ICSI	0.785	1.056	0.123	8.602	< 0.001
a12	ICSI	0.899	1.332	0.130	10.218	< 0.001
a13	ICSI	0.928	1.283	0.120	10.664	< 0.001
a14	ICSI	0.909	1.194	0.115	10.370	< 0.001
a15	ICSI	0.822	1.118	0.123	9.099	< 0.001
b1	OSC	0.799	1.000			< 0.001
b2	OSC	0.791	1.077	0.119	9.031	< 0.001
b3	OSC	0.806	1.075	0.116	9.265	< 0.001
b4	OSC	0.844	1.168	0.118	9.873	< 0.001

Item	Factor	β	B	SE	CR	p
b5	OSC	0.773	0.946	0.108	8.744	< 0.001
b6	OSC	0.759	1.186	0.139	8.544	< 0.001
b7	OSC	0.857	1.249	0.124	10.092	< 0.001
b8	OSC	0.831	1.203	0.124	9.672	< 0.001
b9	OSC	0.843	1.170	0.119	9.870	< 0.001

Note. β = standardized regression coefficient; B = unstandardized regression coefficient; ICSI = Institutional Capacity and Strategic Impact; OSC = Operational Services and Communication.

According to Table 7, standardized factor loadings ranged from 0.760 to 0.928 for the Institutional Capacity and Strategic Impact dimension and from 0.759 to 0.857 for the Operational Services and Communication dimension. All item-factor paths were significant at $p < .001$. These findings indicate that the items were strongly associated with their respective latent variables. Nevertheless, because the confirmatory factor analysis was conducted on the same sample, these findings were interpreted as preliminary support for the scale's two-factor measurement structure.

3.4 Reliability Analysis

Cronbach's alpha and McDonald's omega coefficients were calculated for the overall scale and its subdimensions to evaluate the internal consistency of the TTO Satisfaction Scale. The reliability findings are presented in Table 8.

Table 8. Internal Consistency Coefficients of the Scale.

Variable / Subdimension	Cronbach's Alpha (α)	McDonald's Omega (ω)	Number of Items
Institutional Capacity and Strategic Impact	0.971	0.971	15
Operational Services and Communication	0.945	0.946	9
Overall Scale	0.977	0.978	24

According to Table 8, Cronbach's alpha was .977 and McDonald's omega was .978 for the overall scale. At the subdimension level, both Cronbach's alpha and McDonald's omega were .971 for Institutional Capacity and Strategic Impact. For Operational Services and Communication, Cronbach's alpha was .945 and McDonald's omega was .946.

The coefficients obtained indicate high internal consistency for the overall scale and its subdimensions. These findings show that the items were consistently associated with the relevant construct and subdimensions. Nevertheless, the very high coefficients obtained for the overall scale and the Institutional Capacity and Strategic Impact subdimension may suggest similarity among item contents. It would therefore be useful to retest the scale in different samples and evaluate a shorter form that may reduce item redundancy in future studies.

3.5 Descriptive Statistics for the TTO Satisfaction Scale

Descriptive statistics for the overall TTO Satisfaction Scale score, subdimension scores, and individual items were calculated using the arithmetic mean, standard deviation, minimum, and maximum values. The findings are presented in Table 9.

Table 9. Descriptive Statistics for the TTO Satisfaction Scale.

Variable / Item	M	SD	Min.	Max.
Institutional Capacity and Strategic Impact	3.95	0.91	1.27	5.00
The TTO provides sufficient support for developing my project proposals.	4.01	1.01	1.00	5.00

Variable / Item	M	SD	Min.	Max.
The support provided by the TTO in patent application processes is effective and sufficient.	4.11	0.97	1.00	5.00
The TTO guides me correctly regarding my intellectual property rights.	4.08	0.96	1.00	5.00
The TTO's efforts to establish collaboration with industry are successful.	3.86	1.16	1.00	5.00
The TTO provides sufficient guidance for the commercialization of my projects.	3.54	1.25	1.00	5.00
The TTO plays an active role in university-industry collaboration projects.	3.92	1.15	1.00	5.00
The TTO provides effective support in securing financing for my projects.	3.62	1.17	1.00	5.00
The TTO's expertise in patenting and licensing processes inspires confidence.	3.88	1.10	1.00	5.00
The TTO creates an environment that encourages collaboration among academics.	4.04	1.05	1.00	5.00
The TTO's services contribute to our university's ranking in national/international indices.	4.14	1.04	1.00	5.00
The TTO's efforts to maintain regular communication with academics are sufficient.	3.96	1.05	1.00	5.00
The TTO is effective in helping my projects reach national and international networks.	3.78	1.15	1.00	5.00
The TTO's services are consistent with the vision of a contemporary university.	4.02	1.08	1.00	5.00
The TTO has a structure that supports a culture of entrepreneurship and innovation.	4.18	1.02	1.00	5.00
The TTO manages a transparent process for the protection and commercialization of intellectual property.	4.09	1.06	1.00	5.00
Operational Services and Communication	4.12	0.79	1.33	5.00
I can easily access the services offered by the TTO.	4.24	0.86	1.00	5.00
TTO staff respond to my questions quickly and satisfactorily.	4.20	0.94	1.00	5.00
The training and information activities organized by the TTO meet my needs.	4.07	0.92	1.00	5.00
The feedback provided by the TTO helps me improve my projects.	3.99	0.95	2.00	5.00
The TTO's communication channels are effective and accessible.	4.36	0.84	1.00	5.00
The TTO facilitates the bureaucratic procedures in my project applications.	4.02	1.08	1.00	5.00
The consultancy services offered by the TTO add value to my academic work.	4.01	1.00	1.00	5.00
The TTO motivates me to transform my innovative ideas into projects.	4.08	1.00	1.00	5.00
The seminars and workshops organized by the TTO are current and useful.	4.08	0.96	1.00	5.00
TTO Satisfaction Scale	4.03	0.82	1.50	5.00

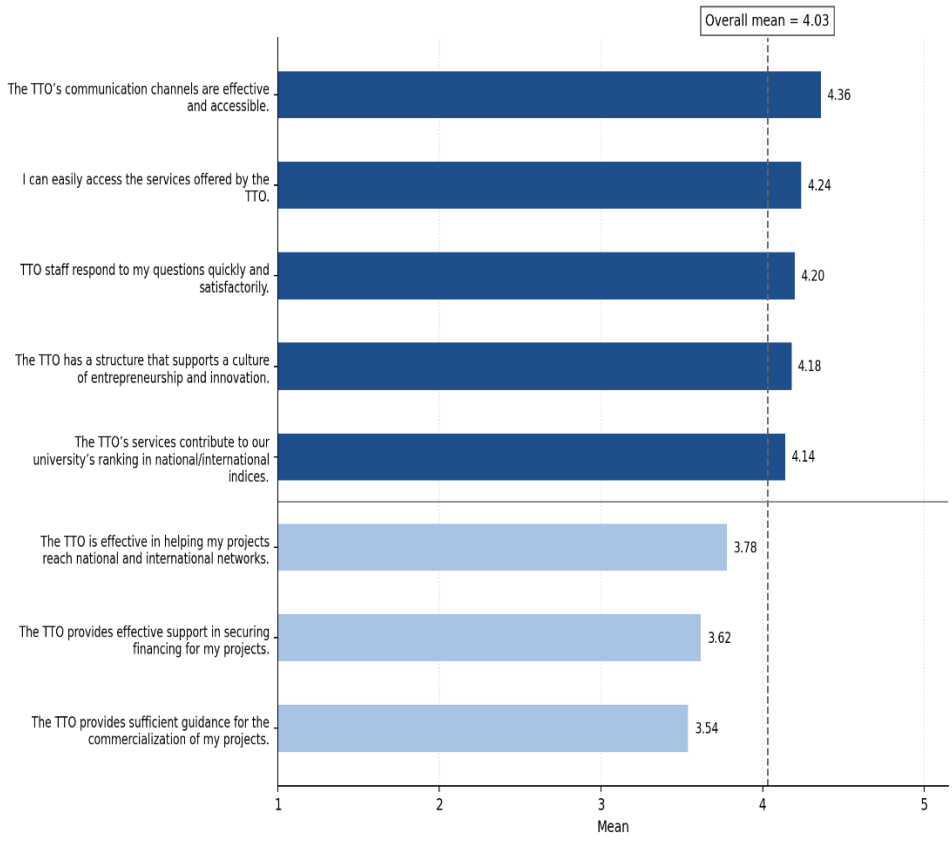
According to Table 9, the overall mean of the TTO Satisfaction Scale was 4.03, with a standard deviation of .82. This value indicates that participants' perceived satisfaction with TTO services was positive. The overall scale scores ranged from 1.50 to 5.00, showing that the responses covered different levels of satisfaction.

At the subdimension level, the mean for Operational Services and Communication was 4.12, while the mean for Institutional Capacity and Strategic Impact was 3.95. This finding indicates that participants evaluated the TTO's operational service processes—such as accessibility, communication, responsiveness, information provision, and consultancy—more positively than its institutional capacity and strategic impact areas.

Within the Institutional Capacity and Strategic Impact subdimension, the highest mean was obtained for the item "The TTO has a structure that supports a culture of entrepreneurship and innovation" (M = 4.18, SD = 1.02). This was followed by "The TTO's services contribute to our university's ranking in national/international indices" (M = 4.14, SD = 1.04) and "The support provided by the TTO in patent application processes is effective and sufficient" (M = 4.11, SD = .97). The lowest mean in this subdimension was obtained for "The TTO provides sufficient guidance for the commercialization of my projects" (M = 3.54, SD = 1.25).

Within the Operational Services and Communication subdimension, the highest mean was obtained for "The TTO's communication channels are effective and accessible" (M = 4.36, SD = .84). This was followed by "I can easily access the services offered by the TTO" (M = 4.24, SD = .86) and "TTO staff respond to my questions quickly and satisfactorily" (M = 4.20, SD = .94). These findings indicate that participants perceived the accessibility and communication dimensions of TTO services as strong.

The descriptive statistics show that perceived satisfaction with TTO services was positive; however, mean scores were relatively lower in areas associated with strategic capacity, such as commercialization guidance, financial support, and access to national and international networks. This finding indicates that TTO services were perceived as stronger in operational service delivery, whereas processes related to generating strategic impact included areas requiring improvement.



Note. The scale ranges from 1 to 5; higher means indicate greater satisfaction.

Figure 3. Strengths and Areas for Improvement in TTO Services.

Fig. 3 shows that stakeholder satisfaction with TTO services was higher in the areas of communication, accessibility, and rapid feedback, whereas relatively lower satisfaction levels were observed for commercialization guidance, financial support, and access to national and international networks.

3.6 Examination of TTO Satisfaction Levels by Sociodemographic Variables

Before examining whether the overall TTO Satisfaction Scale score and subdimension scores differed according to sociodemographic variables, the normality assumption was evaluated using the Kolmogorov-Smirnov test. The analysis results are presented in Table 10.

Table 10. Normality Analysis.

Variable	Kolmogorov–Smirnov Statistic	df	p
TTO Satisfaction Scale	0.119	101	0.001
Institutional Capacity and Strategic Impact	0.127	101	< 0.001
Operational Services and Communication	0.132	101	< 0.001

According to Table 10, the p values for the overall TTO Satisfaction Scale score, the Institutional Capacity and Strategic Impact subdimension, and the Operational Services and Communication subdimension were below .05. This finding indicates that the scale and subdimension scores did not meet the normality assumption. Nonparametric tests were therefore used for group comparisons. The Mann-Whitney U test was used for variables with two groups, and the Kruskal-Wallis H test was used for variables with more than two categories. Rather than determining the scale's core psychometric structure, these analyses were treated as exploratory findings on satisfaction levels across different participant groups. Because the number of participants in some subgroups was limited, the findings from the group comparisons were interpreted cautiously.

3.6.1 Examination by Gender

The Mann-Whitney U test was conducted to determine whether the overall TTO Satisfaction Scale score and subdimension scores differed by gender. The findings are presented in Table 11.

Table 11. TTO Satisfaction Levels by Gender.

Variable	Gender	M	SD	Mdn	Z	p
TTO Satisfaction Scale	Male	3.77	0.87	3.93	-2.725	0.006
	Female	4.25	0.71	4.39		
Institutional Capacity and Strategic Impact	Male	3.69	1.00	3.90	-2.495	0.013
	Female	4.16	0.78	4.20		
Operational Services and Communication	Male	3.85	0.85	4.00	-3.007	0.003
	Female	4.34	0.68	4.44		

According to Table 11, the overall TTO Satisfaction Scale score differed significantly by gender ($Z = -2.725$, $p = .006$). The overall scale mean for women ($M = 4.25$) was higher than that for men ($M = 3.77$). At the subdimension level, a significant gender difference was also found for Institutional Capacity and Strategic Impact ($Z = -2.495$, $p = .013$). The mean for women in this subdimension was 4.16, compared with 3.69 for men. A significant difference was likewise identified for Operational Services and Communication ($Z = -3.007$, $p = .003$), with a mean of 4.34 for women and 3.85 for men.

These findings show that women in the study group reported higher levels of satisfaction with TTO services than men. However, because measurement invariance was not tested and the sample size was limited, these differences were interpreted as exploratory.

3.6.2 Examination by Age

The Kruskal-Wallis H test was conducted to determine whether the overall TTO Satisfaction Scale score and subdimension scores differed across age groups. The findings are presented in Table 12.

Table 12. TTO Satisfaction Levels by Age.

Variable	Age	M	SD	Mdn	χ^2	p
TTO Satisfaction Scale	20-30	4.12	0.79	4.03	2.484	0.648

Variable	Age	M	SD	Mdn	χ^2	p
	31-40	4.04	0.83	4.18		
	41-50	3.80	0.72	3.86		
	51-60	4.21	0.79	4.27		
	61 and older	4.00	1.26	4.38		
Institutional Capacity and Strategic Impact	20-30	4.04	0.91	4.03	1.988	0.738
	31-40	3.95	0.91	4.07		
	41-50	3.70	0.92	3.93		
	51-60	4.16	0.85	4.20		
	61 and older	4.00	1.19	4.37		
Operational Services and Communication	20-30	4.21	0.80	4.39	2.983	0.561
	31-40	4.13	0.80	4.28		
	41-50	3.91	0.58	3.78		
	51-60	4.26	0.74	4.33		
	61 and older	4.00	1.34	4.39		

According to Table 12, the overall TTO Satisfaction Scale score did not differ significantly across age groups [$\chi^2(4) = 2.484$, $p = .648$]. No significant differences across age groups were found for Institutional Capacity and Strategic Impact [$\chi^2(4) = 1.988$, $p = .738$] or Operational Services and Communication [$\chi^2(4) = 2.983$, $p = .561$].

These findings show that satisfaction with TTO services did not vary significantly by age group in the study sample. Because participant numbers were unevenly distributed across age groups, this finding was interpreted as exploratory.

3.6.3 Examination by Academic Title

The Kruskal-Wallis H test was conducted to determine whether the overall TTO Satisfaction Scale score and subdimension scores differed by academic title. When significant differences were observed, Bonferroni-adjusted multiple comparisons were performed to identify group differences. The findings are presented in Table 13.

Table 13. TTO Satisfaction Levels by Academic Title.

Variable	Academic title	M	SD	Mdn	χ^2	p	Difference
TTO Satisfaction Scale	(1) Research Assistant	3.45	0.73	3.19	13.635	0.009	2 > 1
	(2) Other (student, administrative staff, etc.)	4.27	0.70	4.43			
	(3) Associate Professor	3.51	1.09	3.46			
	(4) Assistant Professor	3.93	0.81	4.00			
	(5) Professor	4.26	0.47	4.26			
Institutional Capacity and Strategic Impact	(1) Research Assistant	3.52	0.78	3.27	13.279	0.010	2 > 3
	(2) Other (student, administrative staff, etc.)	4.21	0.81	4.27			
	(3) Associate Professor	3.31	1.19	3.17			
	(4) Assistant Professor	3.82	0.87	3.93			

Variable	Academic title	M	SD	Mdn	χ^2	p	Difference
	(5) Professor	4.21	0.49	4.20			
Operational Services and Communication	(1) Research Assistant	3.38	0.69	3.11	14.167	0.007	2 > 1
	(2) Other (student, administrative staff, etc.)	4.34	0.67	4.44			
	(3) Associate Professor	3.71	1.06	3.72			
	(4) Assistant Professor	4.04	0.79	4.11			
	(5) Professor	4.32	0.47	4.33			

Note. Bonferroni correction was applied to multiple comparisons.

According to Table 13, the overall TTO Satisfaction Scale score differed significantly across academic-title groups [$\chi^2(4) = 13.635$, $p = .009$]. Bonferroni-adjusted comparisons showed that the significant difference was between the "Other" category and the Research Assistant group. Participants in the "Other" category had a higher overall scale mean ($M = 4.27$) than those in the Research Assistant group ($M = 3.45$).

A significant difference by academic title was found for Institutional Capacity and Strategic Impact [$\chi^2(4) = 13.279$, $p = .010$]. Multiple comparisons indicated that participants in the "Other" category had a higher mean ($M = 4.21$) than those in the Associate Professor group ($M = 3.31$).

A significant difference by academic title was also identified for Operational Services and Communication [$\chi^2(4) = 14.167$, $p = .007$]. Bonferroni-adjusted comparisons showed that participants in the "Other" category had a higher mean ($M = 4.34$) than those in the Research Assistant group ($M = 3.38$).

These findings indicate that satisfaction with TTO services may vary across academic-title/status groups in the study sample. However, the small number of participants in certain groups, such as Research Assistants and Professors, limits the generalizability of the results. Therefore, the findings regarding academic title were treated as complementary and exploratory rather than as core psychometric evidence.

3.6.4 Examination by Field of Work

The Kruskal-Wallis H test was conducted to determine whether the overall TTO Satisfaction Scale score and subdimension scores differed according to participants' primary fields of work or research. The findings are presented in Table 14.

Table 14. TTO Satisfaction Levels by Field of Work.

Variable	Field of Work	M	SD	Mdn	χ^2	p
TTO Satisfaction Scale	Other	4.32	0.62	4.36	1.821	0.769
	Natural Sciences	4.02	1.14	4.34		
	Engineering and Technology	4.00	0.87	4.12		
	Health Sciences	3.94	0.78	3.93		
	Social Sciences and Humanities	4.07	0.81	4.03		
Institutional Capacity and Strategic Impact	Other	4.27	0.73	4.43	1.819	0.769
	Natural Sciences	3.87	1.35	4.13		
	Engineering and Technology	3.97	0.88	4.13		
	Health Sciences	3.86	0.84	3.97		
	Social Sciences and Humanities	3.90	1.03	4.00		
Operational Services and Communication	Other	4.37	0.52	4.28	2.461	0.652
	Natural Sciences	4.17	0.94	4.56		

Variable	Field of Work	M	SD	Mdn	χ^2	p
	Engineering and Technology	4.04	0.90	4.22		
	Health Sciences	4.02	0.76	4.00		
	Social Sciences and Humanities	4.24	0.72	4.44		

According to Table 14, the overall TTO Satisfaction Scale score did not differ significantly by field of work [$\chi^2(4) = 1.821$, $p = .769$]. No significant differences among fields of work were found for Institutional Capacity and Strategic Impact [$\chi^2(4) = 1.819$, $p = .769$] or Operational Services and Communication [$\chi^2(4) = 2.461$, $p = .652$].

These findings show that satisfaction with TTO services did not vary significantly by primary field of work or research in the study sample. However, because the number of participants in Natural Sciences and Other fields was limited, the findings were interpreted as exploratory.

3.6.5 Examination by Duration of Using TTO Services

The Kruskal-Wallis H test was conducted to determine whether the overall TTO Satisfaction Scale score and subdimension scores differed according to the duration of using TTO services. The findings are presented in Table 15.

Table 15. TTO Satisfaction Levels by Duration of Using TTO Services.

Variable	Duration	M	SD	Mdn	χ^2	p
TTO Satisfaction Scale	Less than 1 year	4.01	0.96	3.97	0.450	0.930
	1–3 years	4.12	0.75	4.12		
	4–6 years	3.93	0.78	3.98		
	More than 6 years	4.02	0.83	4.19		
Institutional Capacity and Strategic Impact	Less than 1 year	3.98	1.03	4.00	0.530	0.912
	1–3 years	3.99	0.91	4.00		
	4–6 years	3.85	0.81	3.93		
	More than 6 years	3.94	0.91	4.13		
Operational Services and Communication	Less than 1 year	4.04	0.91	4.00	1.005	0.800
	1–3 years	4.25	0.70	4.22		
	4–6 years	4.01	0.79	4.22		
	More than 6 years	4.10	0.81	4.28		

According to Table 15, the overall TTO Satisfaction Scale score did not differ significantly by duration of using TTO services [$\chi^2(3) = 0.450$, $p = .930$]. No significant differences were found for Institutional Capacity and Strategic Impact [$\chi^2(3) = 0.530$, $p = .912$] or Operational Services and Communication [$\chi^2(3) = 1.005$, $p = .800$].

These findings show that the duration of using TTO services did not produce a statistically significant difference in satisfaction levels in the study sample. Although participants who had used the services for one to three years had a higher descriptive mean for Operational Services and Communication, this difference was not statistically significant.

3.6.6 Examination by the Number of Projects Conducted with TTO Support During the Previous Three Years

The Kruskal-Wallis H test was conducted to determine whether the overall TTO Satisfaction Scale score and subdimension scores differed according to the number of projects conducted with TTO support during the previous three years. The findings are presented in Table 16.

Table 16. TTO Satisfaction Levels by Number of Projects Conducted with TTO Support During the Previous Three Years.

Variable	Number of Projects	M	SD	Mdn	χ^2	p
TTO Satisfaction Scale	None	3.83	0.90	3.83	6.515	0.164
	1–2 Projects	4.06	0.77	4.12		
	3–5 Projects	3.97	0.99	4.09		
	6–10 Projects	4.94	0.09	4.94		
	More Than 10 Projects	4.39	0.37	4.48		
Institutional Capacity and Strategic Impact	None	3.70	1.09	3.87	5.752	0.218
	1–2 Projects	3.96	0.84	4.00		
	3–5 Projects	4.01	0.96	4.13		
	6–10 Projects	4.93	0.09	4.93		
	More Than 10 Projects	4.27	0.43	4.33		
Operational Services and Communication	None	3.97	0.80	4.00	6.400	0.171
	1–2 Projects	4.15	0.74	4.22		
	3–5 Projects	3.92	1.04	3.94		
	6–10 Projects	4.94	0.08	4.94		
	More Than 10 Projects	4.51	0.41	4.44		

According to Table 16, the overall TTO Satisfaction Scale score did not differ significantly according to the number of projects conducted with TTO support during the previous three years [$\chi^2(4) = 6.515$, $p = .164$]. No significant differences were found for Institutional Capacity and Strategic Impact [$\chi^2(4) = 5.752$, $p = .218$] or Operational Services and Communication [$\chi^2(4) = 6.400$, $p = .171$].

At the descriptive level, participants in the six-to-ten-project group had higher means for the overall scale and both subdimensions. However, because the number of participants in this group was very small, this finding should be interpreted cautiously from both statistical and practical perspectives. The existing findings indicate that project experience did not produce a significant difference in TTO satisfaction levels within the study sample.

When the sociodemographic comparisons were considered together, significant differences were identified for gender and academic title, whereas no significant differences were found for age, field of work, duration of using TTO services, or number of projects conducted with TTO support during the previous three years. These findings were treated as complementary and exploratory findings concerning the study group rather than as the principal psychometric results of the scale-development study.

IV. DISCUSSION

This study examined the preliminary validity and reliability findings of the TTO Satisfaction Scale developed to measure stakeholder satisfaction with TTO services. The findings showed that the scale displayed a preliminary 24-item, two-factor structure that could be interpreted under the dimensions of "Institutional Capacity and Strategic Impact" and "Operational Services and Communication." The resulting structure indicates that satisfaction with TTO services is shaped both by perceptions of strategic/institutional contribution and by direct service experience.

The item-analysis findings showed that the items in the initial 30-item application form were strongly associated with the total scale score. Item-total correlations ranging from .725 to .900 demonstrate that the items were strongly related to the overall satisfaction score. Nevertheless, high item-total correlations alone do not mean that the component structure of the scale has been adequately determined. Therefore, principal component analysis was conducted after item analysis, and decisions to remove items were made by jointly considering component

loadings, cross-loading status, and theoretical content fit. This approach is important because it integrates statistical findings with theoretical meaningfulness in the scale-development process.

The principal component analysis findings showed that the TTO Satisfaction Scale clustered under a two-component structure. The first component, Institutional Capacity and Strategic Impact, covers evaluations of more strategic service areas, including the TTO's industry collaboration, entrepreneurship and innovation culture, intellectual property management, patenting and licensing processes, commercialization guidance, financial support, and access to national and international networks. This dimension suggests that TTOs are perceived not merely as operational support units within universities, but as institutional interface structures that support the conversion of knowledge into economic and social value.

The second component, Operational Services and Communication, includes service elements directly experienced by stakeholders, such as accessibility of services, effectiveness of communication channels, rapid and satisfactory responses, training and information activities, consultancy services, feedback provision, and facilitation of bureaucratic processes. This dimension shows that satisfaction with TTOs is also related to the daily service experience independently of final output indicators. Given the multi-actor, uncertain, and expertise-intensive nature of technology transfer processes, accessibility and reliable communication channels may be considered fundamental components of stakeholder satisfaction.

The confirmatory factor analysis findings provided preliminary support for the model-data fit of the two-factor measurement model. While χ^2/df, SRMR, and RMSEA indicated acceptable fit, CFI, TLI, NFI, and IFI showed that the model remains open to improvement. The confirmatory factor analysis findings were therefore not interpreted as strong or final validation evidence. Conducting principal component analysis and confirmatory factor analysis on the same sample makes it necessary to retest the model in an independent sample. This was considered a limitation that reinforces the preliminary psychometric nature of the study.

The reliability analyses produced high internal consistency coefficients for the overall scale and its subdimensions. Cronbach's alpha of .977 and McDonald's omega of .978 for the overall scale indicate that the items were consistently related to the measured construct. The high coefficients for the subdimensions likewise support the internal consistency of the two-factor structure. However, very high internal consistency coefficients may suggest similarity or redundancy among item contents [15]. Therefore, future studies should re-examine the distinctive contribution of the items and consider the possibility of developing a shorter form.

The descriptive findings showed that stakeholders participating in the study were generally satisfied with TTO services. The higher mean for Operational Services and Communication than for Institutional Capacity and Strategic Impact indicates that participants evaluated their experiences of accessibility, communication, and day-to-day service delivery more positively. In contrast, relatively lower means were obtained for items related to strategic capacity, such as commercialization guidance, financial support, and access to national and international networks. However, because information on the TTOs from which participants received services was not recorded, these findings should be interpreted solely as descriptive results concerning the service experiences of the study group, rather than as an evaluation of specific TTOs or TTOs in general.

Significant differences were identified for gender and academic title in the sociodemographic comparisons, whereas no significant differences were found for age, field of work, duration of using TTO services, or number of projects conducted with TTO support during the previous three years. The higher satisfaction scores reported by women than by men and the higher satisfaction reported by participants in the “Other” category than by certain academic groups suggest that TTO services may be experienced differently by different stakeholder groups. However, these findings should be regarded as exploratory because measurement invariance was not tested and the number of participants in certain subgroups was limited.

The study developed a measurement instrument for evaluating stakeholders' satisfaction with TTO services and presented evidence concerning the scale's validity and reliability. Existing TTO performance evaluations predominantly use output-oriented indicators such as patents, projects, licensing, entrepreneurship, and commercialization. Although these indicators are important for evaluating the institutional performance of TTOs, they do not provide direct information on how the services offered are perceived and experienced by stakeholders. The developed scale therefore enables service-experience elements—such as service quality,

accessibility, communication, guidance, and perceived contribution—to be assessed in terms of stakeholder satisfaction and provides a complementary evaluation instrument alongside existing performance indicators.

The findings indicate that the TTO Satisfaction Scale provides preliminary psychometric evidence regarding construct validity and internal consistency. However, the scale must be retested in larger and independent samples before it is used as a final instrument. Subsequent studies should strengthen the scale's psychometric properties through quantitative content-validity coefficients and analyses of convergent validity, discriminant validity, criterion validity, test-retest reliability, and measurement invariance.

V. CONCLUSION

This study examined the preliminary validity and reliability findings of the TTO Satisfaction Scale developed to measure stakeholder satisfaction with TTO services. During the scale-development process, a literature-based item pool was created, the items were revised through expert review and pilot implementation, and item analysis, principal component analysis, preliminary confirmatory factor analysis, and internal consistency analyses were conducted using the main-implementation data.

The findings show that the scale displays a preliminary structure comprising 24 items and two subdimensions. The first dimension, Institutional Capacity and Strategic Impact, covers perceived satisfaction with the TTO's industry collaboration, entrepreneurship, intellectual property, patenting, licensing, commercialization, financial support, and institutional contribution activities. The second dimension, Operational Services and Communication, includes elements of direct service experience such as service accessibility, communication, information provision, consultancy, feedback, and process facilitation. This structure indicates that satisfaction with TTOs can be evaluated through both strategic contribution and operational service experience.

The item-analysis findings showed that the items in the initial application form were strongly associated with the total scale score. The principal component analysis findings showed that the preliminary two-component structure was theoretically interpretable. The confirmatory factor analysis conducted on the same dataset provided preliminary support for the model-data fit of this structure, while also indicating aspects requiring improvement. Therefore, the confirmatory factor analysis findings were not treated as final validation evidence.

The reliability analyses yielded high Cronbach's alpha and McDonald's omega coefficients for the overall scale and its subdimensions. This finding provides strong preliminary evidence for the scale's internal consistency. However, the very high coefficients may suggest similarity among item contents. Future studies should therefore re-examine the distinctive contribution of the items and consider developing a shorter form of the scale.

The descriptive findings showed that participants' perceived satisfaction with TTO services was positive. The higher mean for Operational Services and Communication than for Institutional Capacity and Strategic Impact indicates that TTO services were perceived as stronger in terms of accessibility, communication, and day-to-day service delivery. In contrast, areas related to strategic capacity—such as commercialization guidance, financial support, and access to national and international networks—appear to require improvement.

Significant differences were identified for gender and academic title in comparisons involving sociodemographic variables. No significant differences were found for age, field of work, duration of using TTO services, or number of projects conducted with TTO support during the previous three years. These findings suggest that certain stakeholder groups may experience TTO services differently. However, because subgroup sizes were limited and measurement invariance was not tested, these findings should be interpreted as exploratory.

This study proposes a two-dimensional candidate measurement instrument that can be used to assess stakeholder satisfaction with TTO services. Alongside output indicators such as patents, projects, licensing, and commercialization, the scale may contribute to monitoring TTO services through the dimensions of stakeholder experience, service quality, accessibility, communication, and perceived contribution. University administrators and TTO professionals may use findings obtained from the scale to identify strengths and areas requiring improvement in service processes.

The study has several limitations. It was conducted using data obtained from 101 participants. The sample size is limited, particularly for confirmatory factor analysis and group comparisons [16]. Conducting principal

component analysis and confirmatory factor analysis on the same dataset requires the measurement model to be retested in an independent sample. Some items may have different levels of answerability for participants without patenting, licensing, commercialization, or project experience. In addition, because the TTOs from which participants received services and the provinces in which those offices were located were not recorded, the findings cannot be generalized to specific TTOs or regional distributions. Future studies may therefore consider including a "no experience/not applicable" response option.

Future research should retest the scale in larger independent samples that include different types of universities and TTOs at different levels of maturity. Content validity should be supported by quantitative coefficients, and convergent validity, discriminant validity, criterion validity, test-retest reliability, and measurement invariance analyses should be conducted. These analyses will strengthen the psychometric quality of the TTO Satisfaction Scale and contribute to its more reliable use across different stakeholder groups.

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APPENDIX 1. FINAL FORM AND SCORING INSTRUCTIONS FOR THE TECHNOLOGY TRANSFER OFFICE SATISFACTION SCALE

The final 24-item form of the scale developed to measure stakeholder satisfaction with TTO services is presented below. To ensure traceability, the original item numbers from the initial 30-item application form have been retained.

Participants indicate their opinion on each item by selecting one of the following response options: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; 5 = Strongly Agree

A.1 Subdimensions and Items

A.1.1 Institutional Capacity and Strategic Impact

Item No.	Item
M8	The TTO's efforts to establish collaboration with industry are successful.
M27	The TTO has a structure that supports a culture of entrepreneurship and innovation.
M15	The TTO plays an active role in university-industry collaboration projects.
M26	The TTO's services are consistent with the vision of a contemporary university.
M18	The TTO's expertise in patenting and licensing processes inspires confidence.
M25	The TTO is effective in helping my projects reach national and international networks.
M9	The TTO provides sufficient guidance for the commercialization of my projects.
M29	The TTO manages a transparent process for the protection and commercialization of intellectual property.
M7	The TTO guides me correctly regarding my intellectual property rights.
M20	The TTO's services contribute to our university's ranking in national/international indices.
M6	The support provided by the TTO in patent application processes is effective and sufficient.
M1	The TTO provides sufficient support for developing my project proposals.
M19	The TTO creates an environment that encourages collaboration among academics.
M17	The TTO provides effective support in securing financing for my projects.
M24	The TTO's efforts to maintain regular communication with academics are sufficient.

A.1.2 Operational Services and Communication

Item No.	Item
M10	The TTO's communication channels are effective and accessible.
M13	The TTO motivates me to transform my innovative ideas into projects.
M2	I can easily access the services offered by the TTO.
M14	The seminars and workshops organized by the TTO are current and useful.
M12	The consultancy services offered by the TTO add value to my academic work.

Item No.	Item
M3	TTO staff respond to my questions quickly and satisfactorily.
M28	The feedback provided by the TTO helps me improve my projects.
M11	The TTO facilitates the bureaucratic procedures in my project applications.
M4	The training and information activities organized by the TTO meet my needs.

A.2 Scoring Instructions

The scale contains no reverse-scored items. The total scale score is calculated as the arithmetic mean of the 24 items. Subdimension scores are calculated as the arithmetic mean of the items in the relevant subdimension. A higher score indicates greater stakeholder satisfaction with TTO services.

The Institutional Capacity and Strategic Impact subdimension comprises 15 items. Its score is calculated as the arithmetic mean of items M8, M27, M15, M26, M18, M25, M9, M29, M7, M20, M6, M1, M19, M17, and M24.

The Operational Services and Communication subdimension comprises nine items. Its score is calculated as the arithmetic mean of items M10, M13, M2, M14, M12, M3, M28, M11, and M4.

It is recommended that at least 20 of the 24 items be answered to calculate the total scale score. At least 80% of the items in the relevant subdimension may be required to calculate subdimension scores. Forms below these thresholds may be excluded from the analysis.

The following ranges may be used to interpret the scores:

Score Range	Interpretation
1.00-1.80	Very low satisfaction
1.81-2.60	Low satisfaction
2.61-3.40	Moderate satisfaction
3.41-4.20	High satisfaction
4.21-5.00	Very high satisfaction

Items may be renumbered from 1 to 24 in the application form. Retaining the original item numbers in research reports facilitates tracking the transition from the initial 30-item form to the final 24-item form.