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Maturity and Readiness of the Basic Production Process for Televisions in the Industrial Pole of Manaus

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ABSTRACT

The Industrial Pole of Manaus (IPM) is an important mechanism for regional development, in addition to enabling the conservation of the Amazon Rain Forest, operating through the granting of tax incentives and having the Basic Productive Process (BPP) as the main instrument of industrial policy. This article evaluates the BPP of the television product, the one with the highest revenue in the IPM, from the point of view of the manufacturing companies, using a specifically built Maturity and Readiness Model (MRM) composed of six dimensions: search for inter-regional balance, adding value to production, achievement of governmental macro-goals, increase in job offers, promotion of sustainable use of biodiversity and maintenance of fiscal balance. Applied through a structured questionnaire based on the five-point Likert Scale, the MRM showed a global index of 3.59 out of 5, indicating an optimistic view of the manufacturers, especially in terms of job offers. It was adjusted and validated using the methodology of partial least squares in structural equations modeling (PLS-SEM), using SmartPLS® 3.0 software. Perspectives for future studies include the application of the developed MRM to other products with significant revenue and the extension of the research to other stakeholders, especially Governments (federal, state and municipal), research and development institutions and universities.

Keywords
Maturity and Readiness, Television, Basic Production Process, Industrial Pole of Manaus, Industrial Policy.

1. Introduction

Located in the central region of the Brazilian Amazon, the Manaus Free Trade Zone (MFZ) is a well-delimited special tax incentive area of 10,000 square kilometers located at the confluence of the Negro and Solimões rivers, created by Decree-Law 288, of February 28, 1967, encompassing the municipality of Manaus and part of the municipalities of Presidente Figueiredo and Rio Preto da Eva. The purpose of its creation was to generate conditions for the economic development of the Region due to the distance from the country's large consumer centers, and the same legal instrument created the Superintendence of the Manaus Free Zone (SUFRAMA), an autarchy linked to the Ministry of Economy, responsible for the administration of the MFZ (Brasil 1967).

Although originally three development poles were foreseen, namely: industrial, commercial and agricultural, the first is considered the support base of the MFZ, constituting the so-called Industrial Pole of Manaus (IPM), with approximately 500 industries and estimated generation of 500 thousand direct and indirect Jobs (Suframa 2021).

1.1. The Industrial Pole of Manaus

In fact, in 2021 the IPM had global revenues of US$ 32.3 billions (Suframa 2022), registering a monthly average of 103,506 direct workers employed. The evolution of IPM Revenue can be seen in Figure 1:

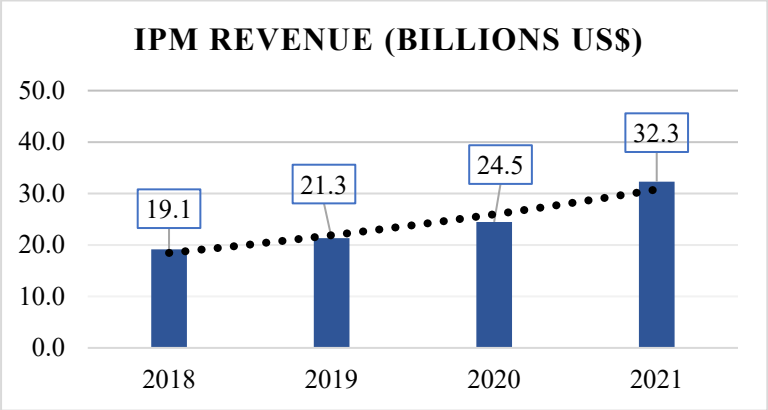

Figure 1. Evolution of IPM Revenue

Holland et al. (2019), using econometric techniques, demonstrated relevance of the IPM by covering externalities such as the evolution of per capita income, education performance, access to services such as water and sanitation, and income inequality indices. Through the synthetic control methodology, pointed out the relative importance of the IPM in the generation of formal jobs, investment in human capital, improvement of infrastructure and housing conditions of the population.

In the environmental context, Rivas et al. (2019) state that the IPM is responsible for the conservation of the Amazon rainforest and is the main reason why the Brazilian state of Amazonas still maintains 97% of its original vegetation covering. They understand that it has a decisive effect on climate balance at a global level. Based on an analysis of the dynamics of the IPM, this hypothesis is validated through econometric studies, discussing possible effects of its extinction. They also present suggestions regarding compensatory mechanisms, indicating that this is a virtuous effect generally not taken into account.

Based on the regional development theories of Gunnar Myrdal (Cumulative Circular Causation), Albert Hirschman (Forward and Backward Effects), François Perroux (Growth Poles) and Douglass North (Export Base Theory), Silva et al. (2019), analyzing demographic growth, employability and gross domestic product indicators, concluded that the Manaus Free Trade Zone model has brought significant progress both to Manaus and to the region, highlighting the contribution of the IPM.

Given the above, one can say that there are enough elements to consider the importance of the IPM as an inducer of socioeconomic development in the Amazon Region, reducing regional inequalities in the country.

1.2. The Basic Production Process (BPP)

The concept of the Basic Productive Process (PPB) was introduced by Law 8,387 of December 30, 1991 (Brasil 1991) and is pointed out by Mendonça (2013) as a public governance policy tool, developed from the change of a closed economy to one more open to imported products. Bispo (2009) signalize the occurrence of significant changes in the Brazilian economy in the period from 1991 to 1996, with significant reductions in import rates, mainly due to Brazil's accession to the World Trade Organization (WTO) in 1995. Compliance with the BPP is an essential condition for an industry to settle in the IPM and obtain the corresponding tax incentives.

The BPP was defined as "the minimum set of operations, in the factory, that characterizes the effective industrialization of a given product". In summary, the BPP consists of the minimum necessary manufacturing steps that companies must complete to manufacture a certain product, along with certain restrictions and/or specific conditions, as one of the counterparts to the tax benefits established by law (Brasil 1967). The BPP is fixed or changed by means of an Inter Ministerial Ordinance of the Ministries of Economy and Science, Technology and Innovation, in accordance with the procedure established by Inter Ministerial Ordinance 32, of July 15, 2019. The procedure starts with the request of the interested party, usually a company or class association, through its own script, but it can also be proposed by the components of the Technical Group. The steps of the procedure are condensed in the flowchart shown in Figure 2 (Brasil 2019):

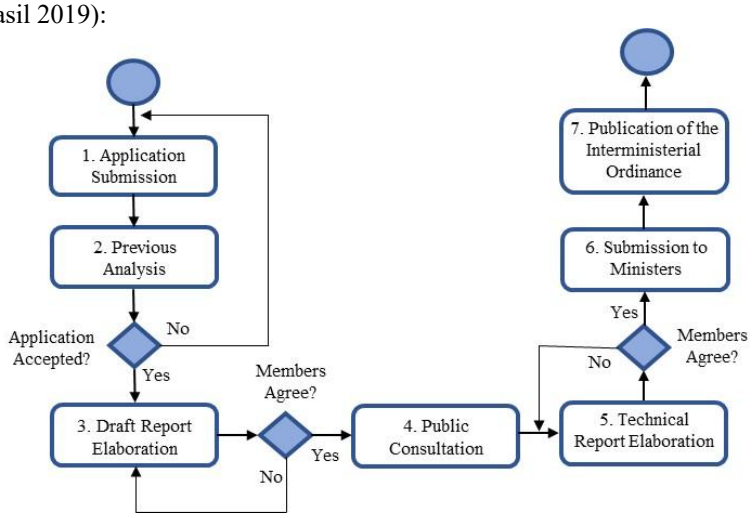

Figure 2. BPP Establishing or Changing Flowchart

The criteria for approval of BPPs are defined in Article 6th and can be can be summarized in the search for interregional balance, adding value to production, achieving the Federal Government's macrogoals, increasing the jobs offer and promoting the sustainable use of Amazonian biodiversity.

Compliance with these criteria is verified in the Previous Analysis phase and is responsibility of the Technical Group Coordination. As can be seen, this condition practically implies that only new products, not yet manufactured in the country, can be produced in the IPM. From a quantitative point of view, the publication of Interministerial Ordinances referring to BPPs deciding on the rejection, filing, alteration and fixation and the ones specific for fixation in recent years can be seen in Table 1:

Table 1. Publication of Inter Ministerial Ordinances referring to BPP

Year	# Ordinances BPP	# Ordinances New Products
2021	101	32
2020	78	14
2019	73	05
2018	49	05
2017	57	09

2016	24	06
2015	81	15
2014	68	15
2013	80	22
2012	79	38
2011	50	17
2010	56	17

Despite the significant volume of publications, the number of Ministerial Ordinances referring to the establishment of BPPs which specifically correspond to the introduction of new products, is significantly lower, indicating low renewal and a potential point of concern for the Federal Government for the continuity of the MFZ. As a result of this situation, currently, 47% of IPM revenue is supported by only five products, and the fourth in revenue, Assembled Printed Circuit Board, constitutes an input for the others, as can be seen in Table 02. The discontinuity of any of these would have a considerable impact on the IPM, and there are already proposals for devices to replace the television, which accounts for the largest share of revenue.

Table 2. Main IPM Products Regarding Revenue

Position:	Product:	Revenue (US$):	Perc. (%):	Accum. (%):
1	Television with LCD screen	4.694.359.215	14,5	14,5
2	Smatphone	3.138.045.612	9,7	24,2
3	Motorcycles, scooters and mopeds	3.075.478.575	9,5	33,7
4	Assembled printed circuit board (for data processing devices)	2.517.424.056	7,8	41,5
5	Split system air conditioner	1.780.028.006	5,5	47,0
6	Microwave oven	454.431.460	1,4	48,4
7	Bicycles including electric (electric-cycle)	236.482.017	0,7	49,1
8	Wrist and pocket watch	225.887.232	0,7	49,8
9	Car radio and audio players	216.735.815	0,7	50,5
10	Split system condensing unit	142.366.205	0,4	50,9
Total:		**13.701.283.198**	**50,9**	

This situation reinforces the interest in investigating the maturity and readiness of the BPP, with the objective of expanding the diversity of items manufactured in order to create greater independence from specific products and increase the total revenue of the IPM.

1.3. Objectives

Due to the importance of the IPM for the Amazon Region and the reduction of the inter-regional imbalance in Brazil, in addition to the fact that today there is a dangerous concentration of revenue in a few specific products, the objective of this article is to address the research gap of the effectiveness of the BPP as a public policy instrument. This investigation is conducted through the construction of a specific maturity and readiness model, based on the requirements set by the Inter Ministerial Ordinance 32/2019 and the Administrative Council of SUFRAMA, to be applied to the manufacturers of the highest billing product: the television with LCD screen.

A literature review in scientific databases with the string "basic production process" AND "industrial pole of manaus" returned only four articles, where three focus on Industrial Capability Building and one in a particular aspect of the BPP for motorcycle, demonstrating the novelty of this research.

2. Literature Review

A Maturity Model (MM) consists of a sequence of maturity levels for a class of objects, typically organizations or processes. It represents an anticipated, desired or typical path of evolution of these objects as discrete stages. The MM

serves as a scale for evaluating the position on the evolutionary path. It provides criteria and characteristics that need to be met to reach a certain level of maturity. Thus, MMs can be understood as artifacts that serve to solve the problem of determining the status quo of a company's capabilities, indicating measures for its improvement. (Becker and Pöppelbuß 2009).

According to Kohlegger et al. (2009), MMs are popular instruments to assess the capacity of certain elements for maturation, for example, of an organization or system, and to select appropriate actions to lead to a higher level of maturity. Maturity has been used as an analytical, explanatory or normative concept in several domains, being structured in a convenient number of sequential phases, separated by essential pre-established conditions.

For Pöppelbuß and Röglinger (2011), MMs represent theories of evolution based on stages, their basic purpose being the description of stages and paths of maturation, referring to various classes of entities. For their practical application, they must present the current and desirable levels of maturity and include the respective improvement measures.

MMs are instruments for measuring the stage of an organization with respect to a specific target situation. Readiness Models, on the other hand, aim to capture their introductory state, allowing the initiation of the development process. Although treated as synonyms, the difference between these concepts is that the readiness assessment takes place before the maturation process, while the maturity assessment aims to capture the state as it is during this process. (Schumacher et al. 2016).

According to Carolis et al. (2017), the terms readiness and maturity are relative and related. It associates “readiness” as a company's ability to implement concepts and “maturity” with how well it has employed these concepts or its capability. According to these concepts, certain maturity models can be seen as part of an assessment of readiness.

For Gökalp et al. (2017), there is a fundamental need to support organizations that are transitioning to the Industry 4.0 environment and guide them to improve their capabilities. Structural approaches such as MMs provide comprehensive guidance and introduce a roadmap. The notion of maturity is used to define, evaluate and form a guideline and a basis for evaluating progress. The main reason for using MM is to describe the level of perfection of the organization for a given situation, the underlying being that with increasing maturity, greater progress is achieved in different aspects, contributing to the organization as a whole.

Before investing in digital technologies and starting their transformation process, it is essential for manufacturing companies to understand their current situation and build their roadmap, according to the level of readiness. This means that the benefits of digital transformation depend on the company's readiness to apply technological transformations more than on the choice of technologies. In fact, a deep understanding of the company's current digital maturity is the first step towards a successful transformation, followed by a clear vision and agenda, shared and adopted by its executives. From this perspective, it is possible to establish a roadmap containing details of transformation by phases (Carolis et al. 2017a).

Azevedo and Santiago (2019) carried out an extensive bibliographic review associating the MMP with the characteristics of agility, flexibility and responsiveness of Industry 4.0, with the objective of identifying the positioning of companies in this new context, validated in an IPM company, concluding that this method is relevant for mapping key business points and developing improvement plans.

De Souza et al. (2021) analyzed articles with a significant JDR impact on the topic and, based on the comparison of 12 existing MRM, pointed out this method as an important instrument for evaluating organizations, highlighting the need to choose the one that best fits their profile..

Given the above, we can understand the importance of using the methodology of the Maturity and Readiness Model as a conceptual framework to understand the effectiveness of the BPP in fulfilling the objective for which the MFZ was created and, consequently, the IPM.

3. Methods

3.1. Research Classification

According to Silva and Menezes (2001) we can classify the present research, in terms of nature, as applied research, since it is aimed at generating knowledge to solve a specific problem. Being, in relation to the approach, quantitative-qualitative, because the information is classified based on numerical criteria, however, it is analyzed in terms of adherence to the proposed theme in a qualitative approach. According to Creswell and Creswell (2018) mixed methods research is an investigation integrating the two forms of information and using distinct designs that may involve philosophical assumptions and theoretical frameworks. The fundamental assumption of this form of inquiry is that the integration of qualitative and quantitative data yields additional insight beyond the information provided by quantitative or qualitative data alone. It can, additionally, be classified as exploratory research, as it aims at greater familiarity with the topic, as well as bibliographic research, since it is developed from previously prepared material (Gil 1991). As for the research technique, it is a case study, for Lüdke and André (1999) composed of three phases: exploratory, systematization of data collection and delimitation of the study and analysis and interpretation of the findings.

3.2. Maturity and Readiness Model (MRM)

In MRMs reflective constructs describe latent variables, which are not directly observable in the study environment, but are manifested through observable variables (indicators). For this specific MRM the latent variables were defined based on Inter Ministerial Ordinance 32/2019, except for the Maintenance of Fiscal Balance, added from the discussions at the meetings of the Administrative Council of SUFRAMA which, since 2019, pointed to the need to create greater counterparts for the tax waiver, especially the creation of direct jobs. The "macro-goals contained in government policies that promote scientific and technological development" were assumed as the Institutional Results stated in the 2020-2030 Strategic Map of the Ministry of Science, Technology and Innovations (Brasil 2020).

The proposed MRM is composed of:

a) Structural Module formed by 6 constructs (latent variables) that represent the elements of the studied model;
b) Measurement Module formed by 29 indicators (observable variables), intended for measuring the constructs.

The description of all variables can be found in Table 04 and the relationship between the latent variables used are presented in the Structural Model of Figure 3:

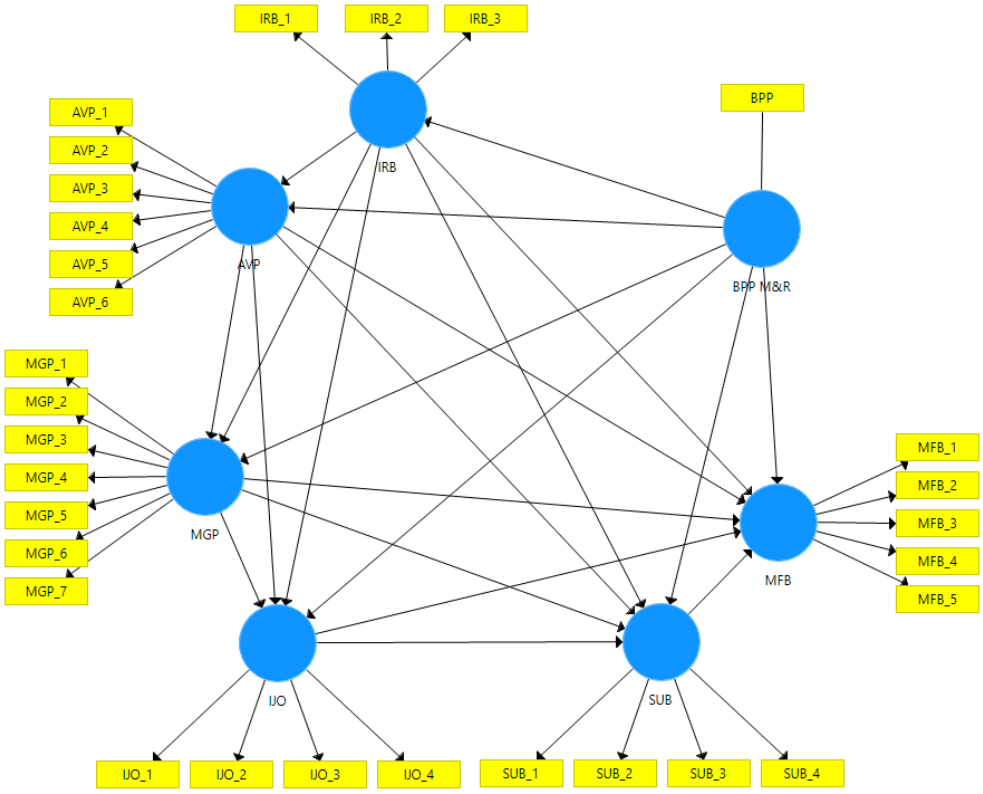

Figure 3. Structural Model

3.3. Validation

For validation of the Maturity and Rediness Model, it was decided to use Structural Equation Modeling (SEM), applied throughout SmartPLS® 3.0 software, which combines different statistical techniques to analyze complex relationships between directly observed (indicators) and indirectly (latent) variables. (Stein et al. 2012, De Souza Bido and Da Silva 2019, Da Silva Pereira et al. 2019).

4. Data Collection

The application of the developed MRM was based on the responses by 33 representatives of the seven television manufacturing industries of the IPM, of a structured questionnaire using the five-point Likert Scale, collected from October to December of 2021, according to Table 3:

Table 3. Companies surveyed

Company:	Respondent:
Local company	4
Chinese multinational 1	3
Korean multinational 1	6
Japanease multinational	5
Brazilian company	5
Korean multinational 2	6
Chinese multinational 2	4
Total:	**33**

Table 4 summarizes the average values found in the research carried out for each construct and indicator, considering a minimum score of one and a maximum of five points, according to the Likert Scale.

Table 4. Average Values Found for Maturity and Readiness

Item:	Construct / Indicator:	Avg.:
IRB	**Search for inter-regional balance**	**2.68**
1	Previously to this BPP there was already national production	2.00
2	Its implementation promoted the relocation of industrial plants already installed in the country to the MFZ	2.00
3	Its implementation contributed to improving the inter-regional balance of the 5 regions of the country	4.03
AVP	**Adding value to production**	**4.10**
1	The implementation of this BPP required large investments	4.27
2	Product technologies and production processes compatible with the state of the art and technique were incorporated.	4.00
3	Increasing levels of productivity are being achieved	4.06
4	It is contributing to increase the competitiveness of the product	3.88
5	Required training and insctruction of specialized personnel	4.30
6	Contributed to the consolidation of existing production chains	4.09
MPG	**Achieving the macro goals contained in government policies**	**3.78**
1	Stimulated research and the transformation of scientific knowledge into wealth	3.61
2	Promoted the innovation, transformation and convergence of broadcasting services	3.70

3	Boosted the application of technologies for sustainable development and the mastery of strategic technologies	3.76
4	Contributed to the strengthening of the research system and improvement of the science, technology, innovation and communications infrastructure	4.03
5	Expand the practice of innovation and entrepreneurship in the country	3.70
6	It stimulated scientific education and the dissemination and popularization of science	3.73
7	Promoted digital transformation in Brazil	3.94
IJO	**Increase of job offer**	**4.23**
1	Production is labor intensive	4.30
2	It implied a significant generation of jobs at other points in the business chain	4.15
3	Favored the introduction of new related/complementary products	4.36
4	Required significant investments in RD&I	4.09
SUB	**Promotion of the sustainable use of biodiversity**	**3.09**
1	This BPP generated demand for regional raw material from the Amazon	2.88
2	Promoted the development of autochthonous production chains	3.12
3	The process of obtaining regional raw materials is sustainable (economic, social and environmental aspects)	3.24
4	The concepts of Circular Economy are observed	3.12
MEF	**Maintenance of fiscal balance**	**3.61**
1	The compensation obtained is compatible with the tax waiver provided for	3.76
2	There is a possibility of exporting the product	3.48
3	There is a prospect of the profit generated by the production staying in the country	3.82
4	The manufacturing company has a predominance of national capital	2.79
5	The implementation of this BPP leverages other businesses	4.18
	Global Average.:	**3.58**

5. Results and Discussion

5.1. Numerical Results

The Global Average of 3.58 on a maximum scale of 5 indicates an optimistic view on the part of BPP television companies regarding meeting the requirements of Inter Ministerial Ordinance 32/2019, especially in job creation. Regarding the IRB (2.68), the low score is due to the existence of the respondents' erroneous understanding that there was no national production of televisions before this BPP (2.00), while there was consensus as to its high contribution to improving the regional balance (4.03). The AVP (4.10) indicated high value aggregation, highlighting the volume of investments (4.27) and the formation of human capital (4.30). In the context of the MGP (3.78), the one with the lowest score was the stimulus to research and the transformation of scientific knowledge into wealth (3.61) and the highest one was the contribution to the strengthening of the local research system (4.10). For the construct with the highest score, IJO (4.23), the highlight was favoring the introduction of related/complementary products (4.36), while the lowest value was attributed to the demand for investments in RD&I (4.09). It should be noted that in Brazil there is specific legislation for IT goods – which is not the case of television sets – where compulsory investments in RD&I are foreseen. In the case of SUB (3.09), there was no greater adherence to this BPP, as the product does not demand materials from the Amazon biodiversity, with the item of lowest score being the generation of demand for regional raw material (2.88). For MFB (3.61), the lowest value was for the predominance of national capital (2.79) and the highest for the fact that the implementation of this PPB leveraged other businesses (4.18). In fact, this is a consolidated market dominated by multinational brands.

5.2. Proposed Improvements

The present research is focused on the television BPP and each manufactured product presents a different BPP, correlated to its own production process and Federal Government policies. In this sense, a natural advance for the improvement of public policies would be the application of the same MRM to other relevant products of the IPM, providing a comparative analysis. Another important improvement, since all respondents are industry representatives,

would be the extension of the research to other stakeholders, especially Governments (federal, state and municipal), research and development institutions and universities.

5.3. Validation

The indicators Average Variance Extracted (AVE), Composite Reliability, Discriminant Validity and Pearson´s Determination Coeficients (R Square) were evaluated for validation. The AVE is a measure of how much, on average, the variables are positively related to their constructs (Pereira et al. 2019) so when its value is greater than 0.5 or 50%, the model is assumed to converge for a satisfactory result (Fornell and Larcker 1981). Table 5 shows the AVE calculated by SmartPLS® 3.0 software for each construct:

Table 5. Validation Indicators

Construct	AVE	AVE Adjusted Model	Composite Reliability Adjusted Model	R Square Adjusted Model
AVP	0,506	0,506	0,857	0,417
BPP	1,000	1,000	1,000	-
IJO	0,627	0,627	0,869	
IRB	0,483	1,000	1,000	0,597
MFB	0,321	0,521	0,762	0,015
MGP	0,568	0,568	0,901	0,477
SUB	0,609	0,612	0,869	0,200

In this first analysis, the IRB (0.483) and MFB (0.321) constructs were found below the convergence value, a situation in which, according to De Souza Bido and Da Silva (2019) the observable variables of the constructs with AVE less than 0.5 must be eliminated in order to perform the model adjustment. By eliminating the variables with factor loadings of lower value, consequently, there will be an increase in the AVE value. In this way, the variables IRB_1, IRB_2, MEF_3 and MEF_4 were eliminated and a new calculation was performed, generating the third column of Table 05, where the criterion was achieved by all constructs.

The Adjusted Model showed convergence of all constructs and was adopted as the object of all subsequent analyses, beginning with the Composite Reliability. This indicator is used to verify if the sample is free of bias or if the answers as a whole are reliable. In this case, values above 0.60 and 0.70 are considered satisfactory in an exploratory research. It is considered more adequate to the methodology of partial least squares (PLS) in structural equations modeling, used by SmartPLS® 3.0 software (Pereira et al. 2019) and is presented in the fourth column of Table 5, demonstrating the reliability of all constructs.

The Pearson´s Coefficient of Determination (R Square) evaluate the portion of the variance of the endogenous variables that is explained by the structural model. For the area of social and behavioral sciences, Cohen (1988) suggests that 2% is classified as a small effect, 13% as medium effect and 26% as large effect. The calculation performed for the R Square can be found in Table 05, showing that all constructs have large effect except for the IRB that was reduced to one observable variable only, because of the adjustment performed.

The Discriminant Validity is an indicator that the constructs are independent of each other (Hair et al. 2014) and can be evaluated from the cross loads that present higher values in their respective constructs than in the others (Chin 1998). When looking at Table 6, we find that the values in the diagonal are always higher than the others, except for one, indicating that the criterion is met satisfactorily:

Table 6. Discriminant Validity

	AVP	BPP	IJO	IRB	MFB	MGP	SUB
AVP	0.711						
BPP	-0.052	1.000					
IJO	0.673	0.118	0.792				
IRB	0.618	0.215	0.272	1.000			
MFB	0.465	-0.138	0.329	0.268	0.722		

MGP	0.722	-0.020	0.676	0.398	0.549	0.754	
SUB	0.401	0.060	0.450	0.294	0.488	0.545	0.782

The indicators selected pointed to the statistical validation of the Adjusted Model based on the PLS-SEM methodology.

5. CONCLUSIONS

This article analyzed the level of maturity and readiness of the Basic Productive Process (BPP), a public policy instrument for granting tax benefits to television manufacturers in the Industrial Pole of Manaus (IPM), in relation to the attributes established by the Federal Government through the Inter Ministerial Ordinance 32/2019 and meetings of the Administrative Council of SUFRAMA.

A Maturity and Readiness Model (MRM) was developed with six constructs (latent variables), namely: Search for Inter-Regional Balance (IRB), Added Value to Production (AVP), Achievement of Macro Goals Contained in Government Policies (MGP), Increment of the Employment Offer (IJO), Promotion of Sustainable Use of Biodiversity (ASB) and Maintenance of Fiscal Balance (MEF). These constructs were evaluated based on 29 indicators (observable variables), organized in the form of a structured research questionnaire using the five-point Likert Scale. This questionnaire had 33 respondents distributed among the seven local manufacturers of the television product and the Global Average of the survey pointed to a Maturity and Readiness index of 3.58 on a maximum scale of 5, denoting an optimistic view of the BPP as a public policy instrument, highlighting the attendance of the latent variable increase in jobs offer with the highest value (4.23) while the achievement of inter-regional balance had the lowest score (2.68).

Since this research was limited to television producers, a perspective for future studies, aiming to evaluate the IPM as a whole, would be to apply the developed MRM to other products with significant revenue. Another important improvement, since all respondents are industry representatives, would be the extension of the research to other stakeholders, especially governments (federal, state and municipal), research and development institutions and universities.

The builted MRM was adjusted and validated using the methodology of partial least squares in structural equations modeling (PLS-SEM), using SmartPLS® 3.0 software, being necessary to eliminate four observable variables to obtain the convergence of all the constructs of the Model.

As a unique result of this article, we can point out the construction of a specific MRM for the BPP, a public policy instrument used in the IPM, validated through the application in a case study for the television product and PLS-SEM methodology, contributing to the advancement of knowledge about the MFZ, a public policy model that has been proven to induce socioeconomic development and environmental conservation in the Amazon.

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