Process optimization model with PERT diagrams and Petri nets

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Abstract

The Dirección General de Gestión de Destino de la Secretaría de Turismo (Sectur), carries out the evaluation and monitoring of the Magical Towns in Mexico, through the Magical Towns Program; with the purpose of improving various aspects that are within said program; which evaluates different quantitative and qualitative parameters.There is currently no precedent for a system to assist in the evaluation of the Magical Towns Program. Therefore, a line and sequential model is presented, adopting the planning characteristics of the PERT and simulation diagrams typical of a Petri Net. Objective is to present an improvement in the current process of management of the Magical Towns Program.

Introduction

The evaluation of the magical Towns can be observed as a system that has a certain number of activities, with a process over time. There is a transition that undergoes several changes, this process can be modeled through a Petri net. However, first, you must obtain the critical activities that Sectur performs for this evaluation. Subsequently, it is presented in a first modeling, which constitutes the subject of research, since it starts from a model of a sequential and linear character to a model of Petri nets.

The Petri net can be a tool for studying systems. The Petri net theory allows to model a system through a Petri net and a mathematical representation of the system. Therefore, the analysis of the Petri net can give important information, about the structure and the dynamic behavior of the system. This information can be used to evaluate the modeling system and suggest improvements or changes. In this way, the Petri net theory is based on the application of Petri nets to the modeling and design of systems.

Petri suggests a more structured and planning-oriented work logic for continuous evaluation of Sectur's processes in the stages of registration, incorporation and permanence in the magical Towns Program. Thus, these processes can be analyzed in a more optimized way, by identifying the logical and temporal sequence in the activities that make up these processes, which are carried out with the purpose of identifying the activities that are critical for the correct completion in time and form thereof. Details are identified to improve, in the current way these activities are carried out, to reduce the current time required for the management of the magical Towns Program.

As a result of this, a more agile process is sought, so that Candidate Localities can have a response to their request in a shorter time and obtain the benefits that the Program can provide them, earlier, through the economic benefit that the Program provides them for the improvement of the Locality; whether for road signs, quality of transport and services, maintenance of drinking water, garbage collection, education, security, among others.

Methodology

In order to construct the model required by Sectur, the PERT diagrams model is used as a basis, which allows in the first instance to define the activities necessary for each of the processes that the Sectur performs for the management of the magical Towns Program, in such a way, that the logical sequence is reflected. As well as the duration in time that must be assigned to each activity, to comply with the schedule assigned by the General Directorate of Tourist Destinations

Once you have the PERT diagram of each of the processes, where each activity and its elements are identified, a new model based on the characteristics of a Petri net is transformed. This, with the aim of improving the proposed model, adding the advantages offered by the Petri net model for process evaluation.

In this way, it is possible to observe the evolution in each of the stages in which there is a Candidate Place in the process of Registration and Incorporation, or, a Magical Town in the processes of permanence. In addition to identifying possible outcome events, by failing to comply with an activity (transition in a Petri net), you have the possibility to enter a return event as long as you still have enough time, or end in a completion event .

That is, the candidate city is not approved or that the magical Town has no possibility of revalidating its title.Next, we describe the Pert diagram and the Petri net (Martino, 1982), (Montaño, 1972).

PERT Diagram

The elements and characteristics of a Pert diagram are stated below:

- **Activities Network,** Is the graphic representation of activities with their events, sequences, interrelations and the critical path. Not only is it called a critical path to the method, but also to the series of activities counted from the initiation of the project to its completion; which, do not have flexibility in its execution time, so any delay that suffered any of the activities of the series would cause a delay in the whole project.You can also target the critical path, such as the series of activities that indicates the total duration of the project. Each activity is represented by an arrow that starts in one event and ends in another.

- **Event**, is the moment of initiation or termination of an activity. It is determined in a variable time between the earliest and the latest possible, initiation or termination. Events are also known as nodes.The initial event is denoted by i and the final event with j. The final event of an activity is the initial event of the next activity.

- **Arrows,** are drawn according to the needs and convenience of presentation of the network. They can be horizontal, vertical, ascending, descending curves, straight, broken, among others.

- **Link**, is used in cases where there is a need to indicate that an activity has an interrelationship or continuation with another, with a dotted line, which has a duration of zero. Several activities can end in an event or start from the same event.

Pert network has bans, which should be avoided, such as: Two activities, which use the same start and end event; Activities that do not start in one event and end in another event; And that there are loose events.

Matrix of Elasticity. Refers to the probabilities of delay or advancement of work activities.

First, the slacks are calculated, which provide the possibility of delaying an activity without consequences for other jobs.

Slack is the freedom that has an activity to lengthen its execution time without affecting other activities. There are three kinds of slack:

- Total slack, where it is time delay, does not affect the completion of the project.
- Free play, where the delay time does not change the completion of the process.
- Independent play, where time does not affect the termination of previous activities, nor the initiation of subsequent activities.

Actors in the project are related to the gaps, as follows: The project manager, is related to total slack; the head of execution of a process with free play; And the coordinator of the project work with the independent play.

PETRI Net

Petri net is a modeling tool, which can be applied in systems to describe system information, which presents asynchronous, distributed, parallel, non-deterministic and / or stochastic concurences. Petri nets can be applied in software development.

Definition 1. A Petri net is a particular type of directed graph with two types of nodes (places and transitions). It is denoted by an algebraic structure *PN* = (*P*, *T*, *I*, *O*) where:

$P = p_1, p_2, \dots, p_m$, represents the set of places,
$T = t_1, t_2, \dots, t_n$ the set of transitions.
$I: P \times T \rightarrow N$, The entry function, in which the transition entry points are specified, with $N = 1,2 \dots n$ and
$O: P \times T \rightarrow N$ The output function of the transition with $N = 1,2$ ...n
Besides $P \cap T = \emptyset$.

Places are represented as circles and transitions with bars or boxes. An arc directed from a place p to a transition t defines an input of said transition. A directed arc of a transition t to a location p defines the output of the transition. Sometimes it is necessary to place weight values at the arcs and is denoted as w (p, t), where w is the function:

$w: (P \times T) \cup (T \times P) \rightarrow N$.

When an arc has not indicated its weight value, by default, it is taken to value 1.

Definition 2. A m mark of a Petri net is a function $m: P \rightarrow N$, which assigns to each place p∈P a number of tokens. The presence or absence of tokens indicates the state of a place, and the place mark represents the availability of a resource, or the occurrence of operations.The mark assigns to each site a non-negative integer. Graphically put k points in a place p, if it has associated k tokens. A mark is denoted by M, which is an m vector where m is the total number of places. The p-th component of M, denoted by M (p), is the number of tokens in the p-position.When modeling systems, two fundamental concepts are taken into account: conditions and events (which are generated from the conditions). Petri nets represent conditions as places and events as transitions. A transition (event) has a number of input and output locations, which represent the preconditions and the subsequent conditions of the event, respectively.

The behavior of many systems can be described in terms of the states of the system and their changes. In Petri networks, to simulate the dynamic behavior of a system, a state or brand of the network changes according to the following transition rules:

1. It is said that a transition t is enabled, if each place p of entry of *t* has at least *w (p, t)* tokens, where *w (p, t).* Is the weight of the arc from *p* tot.
2. An enabled transition may or may not fire (depending on which event takes place or not).
3. A trip of an enabled transition t removes *w (p, t)* tokens from each input location p of t, and adds a *w (t, p)* tokens for each output location p of t, where *w (t, p)* Is the weight of the arc from t top.

Source transitions have no entry points and are always enabled. A transition without exit sites consumes tokens.There is an auto cycle, when a pair of nodes, a place p and a transition t, meet: p entry and t exit. A simple network lacks auto-cycles.A graph denoted as G is a tuple G = (V, E), where V is the finite set of vertices or nodes and E represents the set of edges (Johnsonbaug, 1999).It is said that any edge e∈E is incident on a member of P and a member of T.A Petri net contains two types of nodes; the circles that represent places and the bars that are the transitions. Directed arcs connect places and transitions.Pert and Petri allow in this work, to propose an algorithm of creation of the model. By having the construction of the PERT diagram, you can start with the construction of the model following the transformation algorithm, which provides the steps to convert the model based on PERT diagram to a new model that incorporates the benefits of analysis of a Petri net.

For the purpose of this study, the construction of an algorithm in the analysis of the processes of Incorporation and Permanence of the Magical Towns of Mexico is presented.Next, the proposed algorithm is described.

Development

This section presents a proposed model, which arises from applying the Pert and Petri benefits to analyze the flow of information in the Registration, Incorporation and Permanence process of the magical Towns Program.

Algorithm of transformation of diagram PERT to network of Petri

From a PERT diagram, it can be transformed into a new model based on a Petri net, so as to take advantage of the main advantages of both models; By identifying in a simpler way the events, in which, can be made improvements in the process carried out by the Sectur to optimize and improve it, as well as to find flaws in the sequence logic of the scheduled activities.

In order to apply this algorithm, you must remember the characteristics that are defined before and that the PERT diagram must contain. So that the transformation is much clearer, simpler and immediate and fulfills the aforementioned objectives.The necessary elements are then listed in a PERT diagram to be able to apply the transformation algorithm (Joel, 2016):

- An A set of activities that make up the PERT diagram, denoted by:
  - A: $\{\alpha_1, \alpha_2, \alpha_3 \ldots \alpha_n\}$, where $\alpha_i \in A$ y α_i is an activity from PERT diagram.

- Each activity α_i has the following functions:
  - $\gamma(\alpha_i) = T_1$: Which defines the earliest start time T_1. To calculate this indicator, the network must be traversed from left to right and considering the following:T_1 from the first node equals 0. $\gamma(\alpha_0) = 0$.
  - T_1 of node n (node to be calculated) is equal to T_1 from node n-1 (previous node) Plus the duration of the activity (estimated time) ending at node n. This is:$\gamma(\alpha_i) = \gamma(\alpha_{i-1}) + d$.

- If a node ends more than one activity, it takes the time of the activity with the highest value. $\delta(\alpha_i) = T_2$: This function defines the later time of completion (T_2). To calculate this indicator, the network must be traversed from right to left and considering the following: T_2 from the last node (α_n) equals its own T_1. So that:$\delta(\alpha_n) = \gamma(\alpha_n).T_2$ from node n = T_2 from node n-1 (Previous node, from right to left) minus the duration of the activity that starts (estimated time). This means: $\delta(\alpha_i) = \delta(\alpha_{i+1}) - \gamma(\alpha_i)$.

- If a node ends more than one activity, it takes the time of the activity with less value.

  - $\rho(\alpha_i) = H$: slack time, the difference between T_2 y T_1. This slack, given in units of time, corresponds to the value at which the occurrence of an event may be delayed. The events in which the slack is equal to 0 correspond to the critical path, that is to say that the occurrence of these events cannot take a single unit of time with respect to the established schedule, since in the case in which it would take delay the completion of the project.

- A *B* set of arcs connecting each of the nodes of the PERT diagram..

  - B: $\{\beta_1,\ \beta_2, \beta_3 \ldots\ \beta_n\ \}$, where $\beta_i \in B$ Is one of the arcs belonging to the set, each arc is defined by the ordered pair: $\beta_i = (\alpha_i, \alpha_j)$, where α_i indicates the node from which it leaves and α_j the node on which it terminates.

As you can see, the following elements are eliminated; **later start time and earlier end time**, this is because for the model under construction these are not required to carry the sequence analysis.
Once the elements to be used with the PERT diagram are defined, the resources required to assemble the proposed new model must be indicated, then these elements are listed to be related (correspondence):

- A ρ set of places that make up the Petri net denoted by:
  $\rho: \{p_1,\ p_2, p_3 \ldots\ p_{n,}\}$ where $p_i \in \rho$ Is one of the places that belongs to the whole.
  Each place p_i has this characteristics:

Each place may or may not have a m mark, this is a function defined by: $m: p \rightarrow N$, which assigns to each place p $\in \rho$ a number of *token*s. The presence or absence of tokens indicates the state of a place, and the place mark represents the availability of a resource, or the occurrence of operations.

- The mark assigns to each site a non-negative integer. Graphically, *k* points are placed in a p_i place, if it has *k* tokens associated. A mark is denoted by M, which is an m vector where m is the total number of places. The p-th component of M, denoted by M (p_i), is the number of tokens in the p_i place.

- One set τ of transitions that make up the Petri net, in other words:$\tau: \{t_1,\ t_2,\ t_3 \ldots\ t_n\}$ where $t_i \in \tau$ Is one of the transitions that belongs to the set,every t_i transition has the following characteristics:
  - An input function I: $\rho\ X\ \tau\ \rightarrow N$, that describes p_i places of entry to the transition.
  - An output function: $\rho\ X\ \tau\ \rightarrow N$, that specifies p_i places of exit to transition.
  - It is considered that a transition t_i is enabled, if each place p_i of input t_i has at least $w(p_i, t_i)$ *token*s, where $w(p_i, t_i)$ is the weight of the arc from p_i to t_i.
  - An enabled transition may or may not fire (depending on which event takes place or not).
  - A trip of an enabled transition t_i removes $w(p_i, t_i)$ *token*s From each entry point p_i from t_i, and adds $w(t_i, p_i)$ *token*s for every exit place p_i de t_i, where $w(t_i, p_i)$ Is the weight of the arc from t_i to p_i.
  - Transitions that do not have entry points are called source transitions. A source transition is always enabled. On the other hand, a transition without exit sites consumes tokens, but does not produce them.
  - It is said that there is a motorcycle, when a pair of nodes, a place p and a transition t, meet: p is the input and output of t. A network that lacks auto-cycles is called a simple network.

– An arc directed from a p_i place to a transition t_i defines an input of said transition. A directed arc of a transition t_i to a p_i place defines the exit of the transition. Sometimes it is necessary to place weight values at arcs and is denoted by $w(p_i, t_i)$, where w is function: $w: (\rho\ X\ \tau) \cup (\tau\ X\ \rho)$.Taking into account the above definitions, the following is the transformation algorithm (Joel, 2016):

1. Each activity α_i transforms to a p_i place acquiring its attributes (T_1, T_2, H).
2. Each event (Arc in PERT diagram), β_i transforms in a transition t_i where input functions I, and output O, will be defined by the ordered pair $\beta_i = (\alpha_i, \alpha_j)$, considering that α_i y α_j Have already been converted to places p_i y p_j respectively, being p_i assigned to the input function I, y p_j to the output function O.

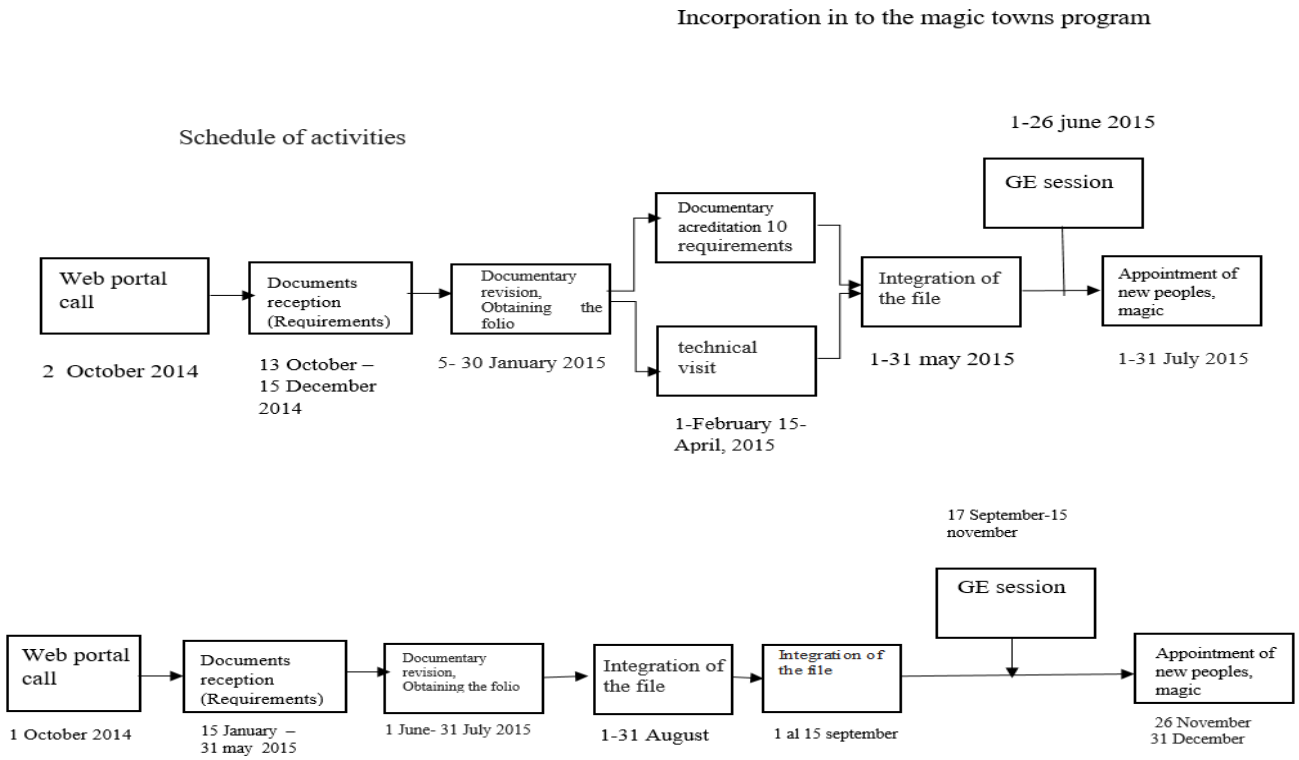
a. Each p_i place must be connected with its respective transition t_i p or by means of an arc that is assigned according to the functions of input and output of said transition, the weight assigned to each arc $w(p_i, t_i)$ or $w(t_i, p_i,)$ as the case may be, is assigned with a value equal to one.

To each transition is added an extra place of exit, which aims to indicate the failed state of the transition. The latter, depending on the nature of the process, can be assigned another return transition as long as the duration and slack allows.

Practical Case

In this case study, the processes of Registration and Integration of the magical Towns of Mexico Program of the Directorate General of Destination Management in the Sectur are used for the construction of the proposed model. In addition to the transformation algorithm, to obtain the final product of a model based on Petri nets.To know the detailed processes of Registration, Incorporation and Permanence of the magic towns Program of Mexico see Annex A.Initially, we observe the actual process that is used (Sectur, 2011), which, is detailed in Figure 4.

Figure 4 Current SECTUR process model. Final Sectur Guide 2015



From the previous figure, you can identify the activities that belong to the process of Registration and Incorporation to the magical Towns Program. It also identifies the duration of each of these activities, through the established schedule.Based on figure 1, an activity matrix is created to gather the necessary information and to create the PERT diagram (Table 4)

Table 4 Matrix of activities of the process of registration and incorporation to the program "Magical Towns ". *Elaboration (Joel, 2016)*

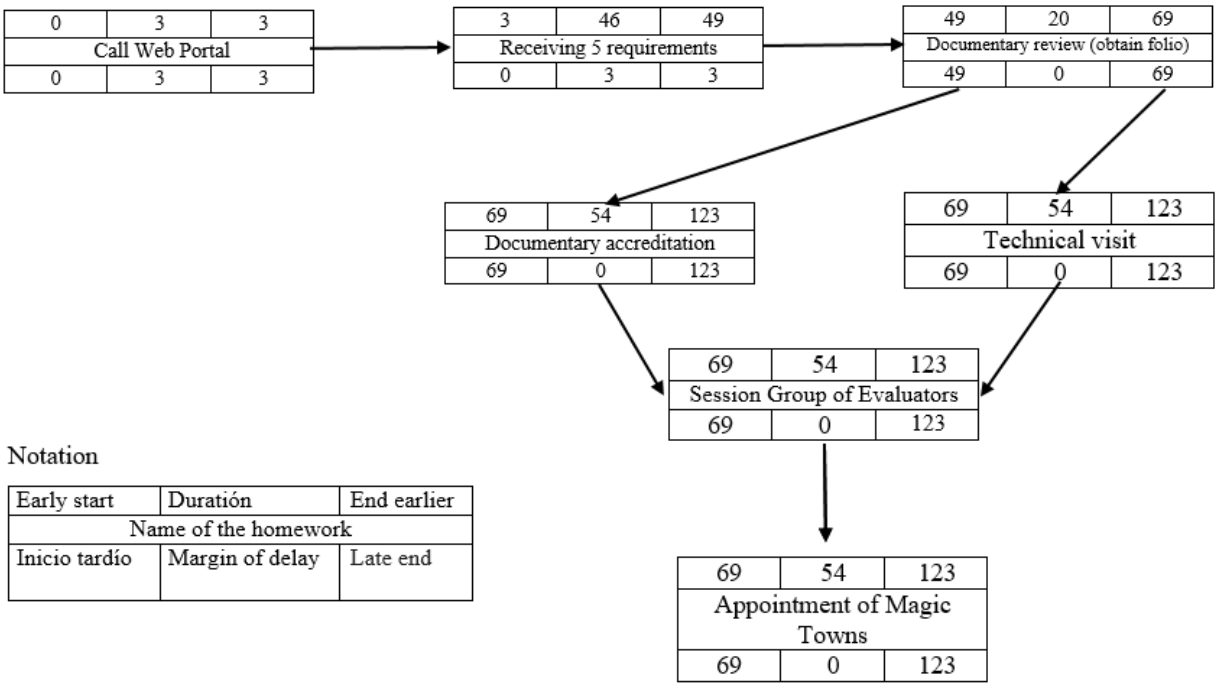
Task	**Duration (days)**	**Star**	**End**	**Prodecessors**
1.- Call for web portal	3	09/10/14	12/10/14	
2.- Receipt of documents (5 requirements)	46	13/10/14	15/12/14	1
3.- Documentary revision (obtaining of folio)	20	05/01/15	30/01/15	2
4.- Documentary accreditation (10 requirements)	54	01/02/15	15/04/15	3
5.- Technical visit	54	01/02/15	15/04/15	3
6.- Integration to the file	22	01/05/15	31/05/15	4,5
7.- GE Session	22	01/06/15	30/06/15	6
8.- Appointment of new magical Towns	23	01/07/15	31/07/15	7

With the activity matrix, the PERT diagram is constructed, in which the times are added, which are: the earliest start, late start, early completion and late completion. As well as, the slack of each of the activities that are identified.To start drawing the diagram, the node of each activity must be initially linked in a sequential and unidirectional way, according to the previous activity matrix; at the end of the layout of the nodes, a tag is added that identifies each activity, and is assigned its duration. With the duration, the route of each one of them is realized, to assign the later time of beginning, in which, the greater amount is obtained that is obtained, summing the time of later completion, the greater one from the coming activity, with the duration of the previous activity.

This time is considered for the initial activity as zero.
The earliest start time is assigned, and then the later end time is set. To assign it to each node, the final activity is identified, to which the later start time will be equalized with its later end time, from the node of the final activity, the predecessor activities will be assigned their time of Late completion; this is taken and the duration of the next activity is subtracted; and is assigned only if it is the lowest value, in case of having more than one consequential activity.

To obtain the slack of each of the activities, the difference between the later end time and the later start time is made, within the proposed diagram, there are activities whose play has the value of 0, the ordered sequence of each of these activities, shows the critical path; that is to say, the series of activities in which, one cannot have a delay in its fulfillment, since it impacts in the finalization in time of the process.In figure 4.1, the constructed diagram of the Registration and Incorporation process is shown:

Figure 4.1 PERT diagram of the processes of Registration and Incorporation to the program "Magic Towns". *Elaboration (Joel, 2016)*

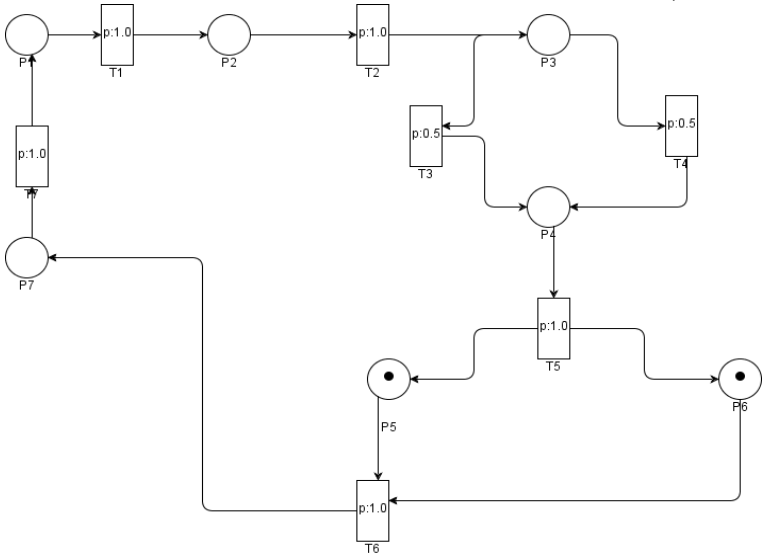


At the end of the drawing up of this diagram, it can be observed that each of the activities is critical, that is, at any time in the current process there are slacks with a duration of 168 days.

First model based on Petri nets

After applying the transformation algorithm explained above, a first model is obtained. It is a total of seven places, which denote the different states that are the process of registration and incorporation. In addition to 7 transitions that are responsible for carrying out the change between the different states. For this first model, the deadlock locations, ie the states in which it is considered as the failed process, have been eliminated. For the case study it is considered that these places are reached by not complying with the requirements established by SECTUR in time and form (Figure 4.2).

Figure 4.2 First model based on Petri nets. Elaboration (Joel, 2016)



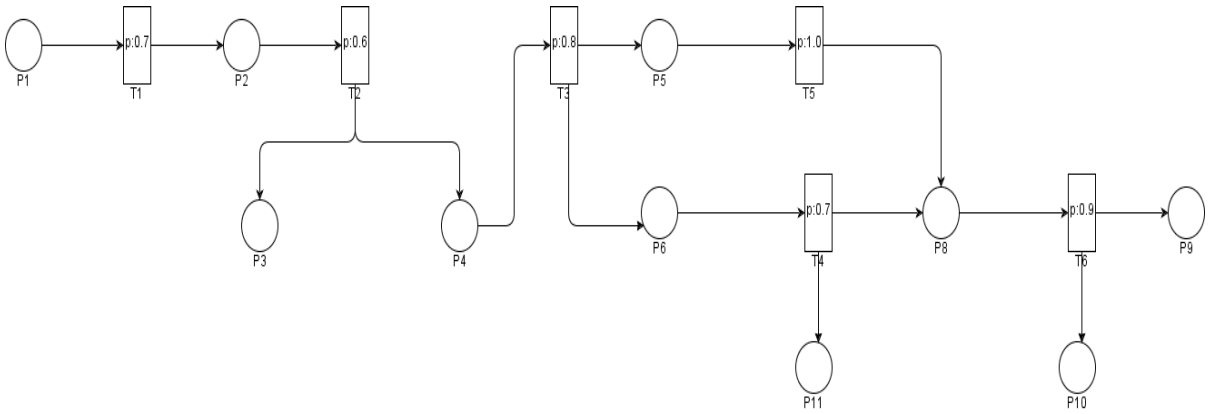
Results obtained from the first model

For this first model, because we do not consider premature completion sites, we cannot know at what point in the process there are critical transitions for the same, that is, the transitions that are decisive to reach the last state within the process.Unlike the model based on the PERT diagram, this is not so intuitive. However, when performing the simulation we can obtain the possible outcomes of the process.

Second model based on Petri nets

A second model of the registration and incorporation process is created considering places of premature completion, that is, states in which the process for each of the magic towns is considered as failed, that is, they must wait until the next call for to start the registration process (Figure 4.3).

Figure 4.3 Second model based on Petri nets. *Elaboration (Joel, 2016)*



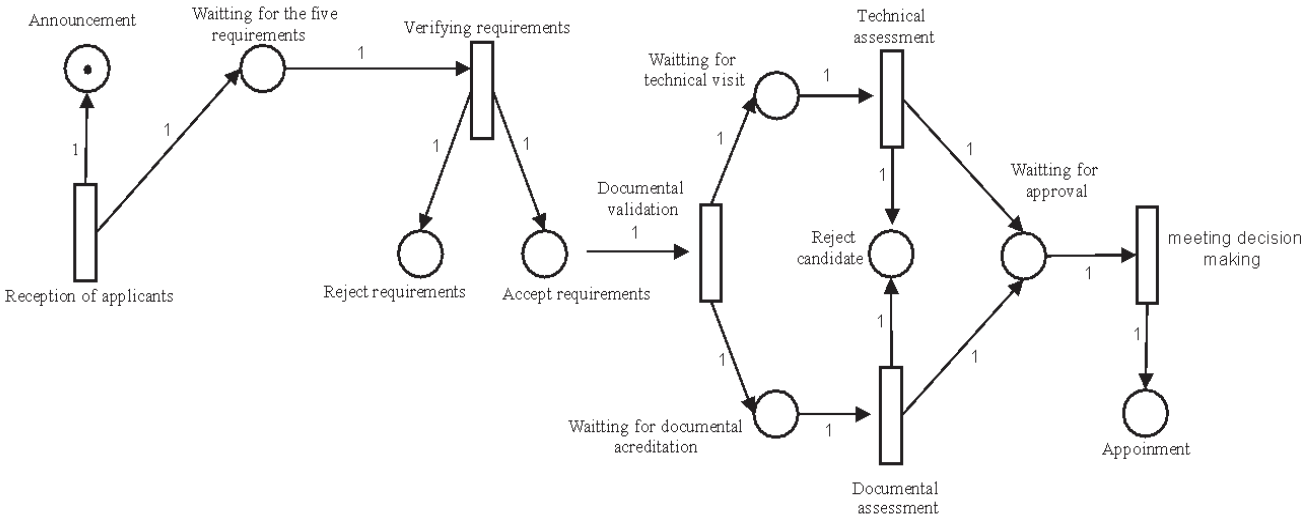
Results obtained from the second model based on Petri nets

For this second model to include places that do not have recovery, the number of places increases to 11, 3 of which belong to this type of states, the number of transitions remains the same as in the first model. This allows us to observe the places in which, before reaching the transition, its output function has as a possible result a state in which the process is considered to be unsuccessful. This means that special attention must be paid to these transitions; since their values determine the statistics that a community joins the program or has to wait for the next call.

However, this second model already incorporates the appropriate places and transitions that shape this process of registration and incorporation; it is necessary to identify each of them as was done with the PERT diagrams, where a label with a name that is indicative and explanatory within the network is assigned to each place and transition. In order to understand more easily what is happening in the Petri net, a descriptive label is added to each site and transition only to the network diagram, since it would not be part of the definition of the mathematical model mentioned above.

Also, the weight of each bow is indicated with a label that represents its value, the latter label being negligible, since for the specific case of this model all weights correspond to 1. However, they are placed for descriptive purposes only this model.In figure 4.4, this same second model is shown by adding the identification tags for each of the transitions and places.

Figure 4.4 Second model based on Petri nets (labeling). *Elaboration (Joel, 2016)*



Simulation of the resulting model

In the simulation of the previous model, a total of 70 repetitions are used in an individual way of this process, since on average a total of 70 applications are received annually to join the program "Magic Towns", obtaining the following points to highlight:

1. Particular attention should be paid to the transitions that have to exit, some of the states in which the process is considered as failed, since each of them experiences a probability of 20% in triggering the same.
2. Documentary review times of the process should be reduced because in these states they consume the majority of the time spent.
3. There are few places that are done in parallel with others, which causes a great temporary dependence on their predecessors.
4. A total of 27 applicants are discarded from the process after passing the 5 requirements revision transition.
5. On average 16 applicants are discarded, after the documentary evaluation, whereas in the technical evaluation they were only 4.

Due to the above points it is proposed to modify the registration and incorporation process, so that more actions can be carried out in parallel and reduce the time in the document review activities.

Results obtained from the analysis

It is proposed to carry out parallel activities, which will help to optimize document review times. The table below shows the activities, if the process starts on November 30, 2016. When you make the difference between start and end dates, there are 148 days including Saturdays and Sundays, if these days are spread, it’s reduced to 105 working days.

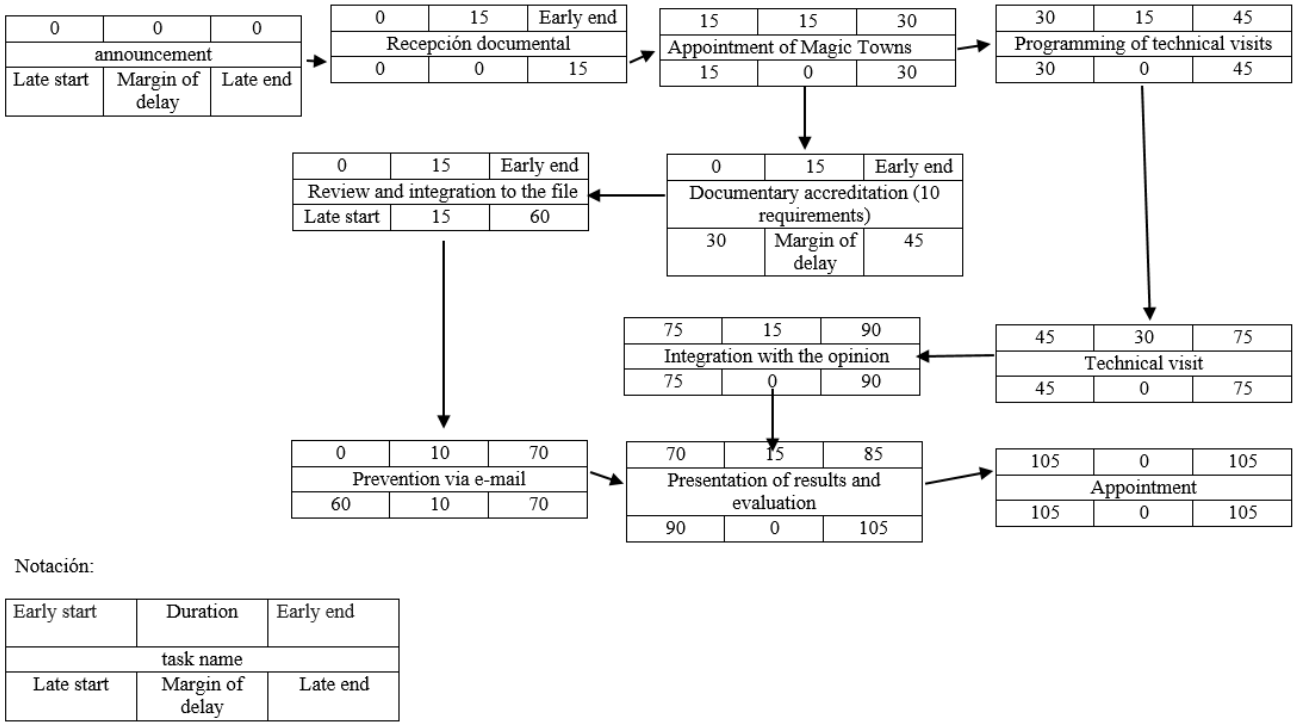
Table 4.1 Matrix of activities of the proposed new model

Task	Duration	Start	End	Predecesrors
Announcement	0 days	30/11/16	30/11/16	
Documentary reception	15 days	30/11/16	20/12/16	1
Documentation validation (5 requirements)	15 days	21/12/16	10/01/17	2
Accrediting documents (10 requirements)	15 days	11/01/17	31/01/17	3
Programming of technical visits	15 days	11/01/17	31/01/17	3
Review and Integration to the file	15 days	01/02/17	21/02/17	4

Technical visits	30 days	01/02/17	14/03/17	5
Email Prevention	10 days	22/02/17	07/03/17	4,6
Integración al dictamen	15 days	15/03/17	04/04/17	7,8
Presentation of results and evaluation	15 days	05/04/17	25/04/17	9
Appointment	0 days	26/04/17	26/04/17	10

In Figure 4.5, the proposed process is modeled.

Figure 4.5 Model proposed from analysis. *Elaboration (Joel, 2016)*



Conclutions

It proposes a restructuring based on the processes that SECTUR carries out. Since previously, Sectur consumed a lot of time in each process. Identification of the main processes that SECTUR carries out in Incorporation and Permanence.It is possible to model with the diagrams based on the PERT-CPM methodology, and identifies the duration of the activities of the two processes that SECTUR performs for the evaluation of the magical Towns Program. This makes it possible to observe that the total duration of the general procedure that until last year made the Sectur consists of 322 days.

A basic mathematical model is obtained, which describes the PERT-CPM dimensioned to be used as a graph, being a support for the development and design of the model enriched with the characteristics of a Petri net (proposed algorithm).

Annex A

The present annex contains the processes of Incorporation of the Localities to be Magical Town and Permanence of the Magical Towns of Mexico; hich is carried out by the General Directorate of Destination Management in the Tourism Secretaríat and are taken up verbatim from (Turismo, 2015). Flow diagrams are incorporated, which are performed by (Joel, 2016) and detail the information flow of these processes.

Modeling requirements requested to candidate locations based on sequence diagrams

The following are the requirements of the Sectur and the flowcharts that detail these requirements.

Registration process

For a community to be a candidate to join the program, it must meet 5 requirements to complete the first stage called registration, currently SECTUR creates a call through its web portal, which indicates these elements necessary to start the registration process. Next, the necessary elements are detailed, as well as the very process that SECTUR carries out.

Registration elements

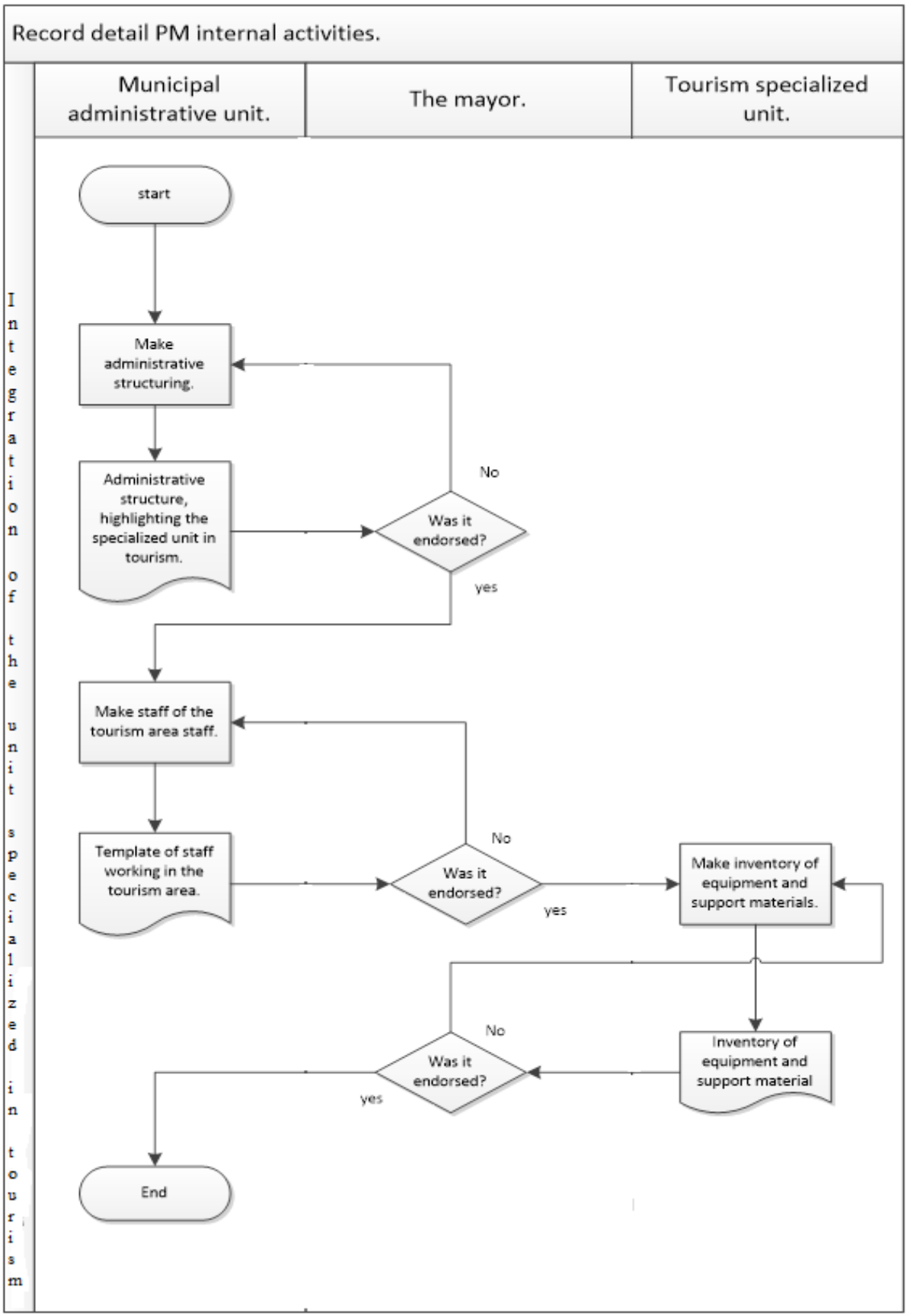
1. The postulant locality must have an area or administrative unit dedicated to tourism with decision-making power

a. Present the document showing the administrative structure, in which the tourism unit stands out, the document must be endorsed by the Municipal President in function

b. Show the template of staff working in the area of tourism of the municipality, endorsed by the Municipal President in function.

c. Present the inventory of equipment and support materials (telephone number, email, furniture and equipment), endorsed by the person in charge of administration.

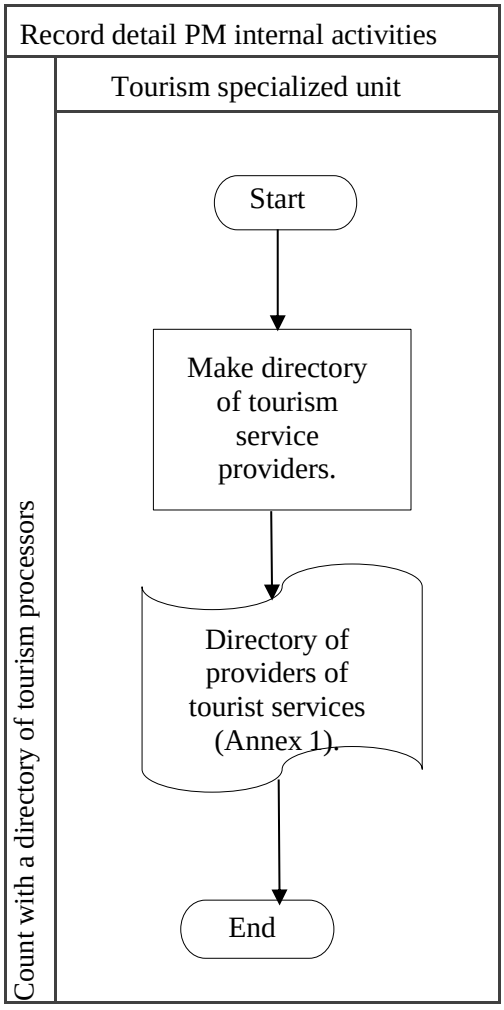
Figure 4.6 Sequence diagram of the first registration requirement



2. Keep directory of tourism service providers

a. To present the directory of providers of tourist services, called for Sectur Annex 1. The second requirement, shown in the diagram in

Figure 4.7 Sequence diagram of the second registration requirement.



3. Have an inventory of resources and tourist attractions in the municipality

d. Present the inventory of resources and tourist attractions which must indicate the physical state of the same and that are susceptible of tourist use (highlighting the declared properties or be appropriate to be classified as a zone of historical monuments, by some institution of state or federal level, Called Annex 2).

This third requirement is developed in the diagram in 4.8:

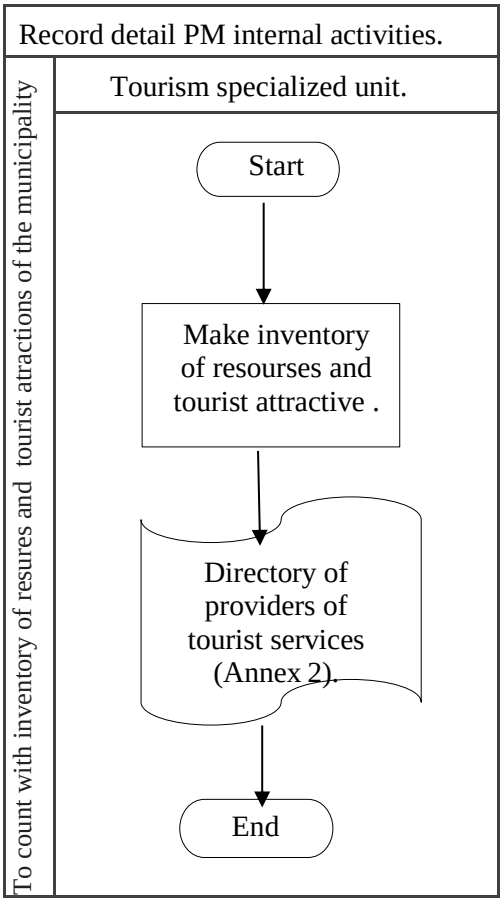
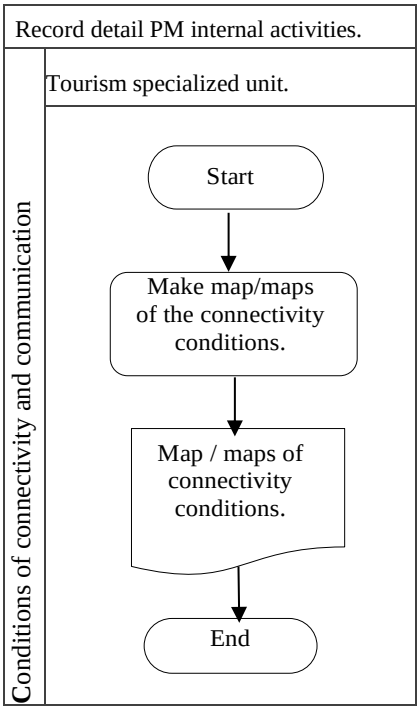


Figure 4.8 Sequence diagram of the third registration requirement

4. Connectivity and communication conditions

e. Show on the map the conditions of terrestrial connectivity from urban distribution centers (not exceeding two hours of land transport) by adding the following elements: fixed-routes for public transport, land and air category.The fourth requirement, shown in the diagram in Figure 4.9 :

Figure 4.9 Sequence diagram of the fourth registration requirement

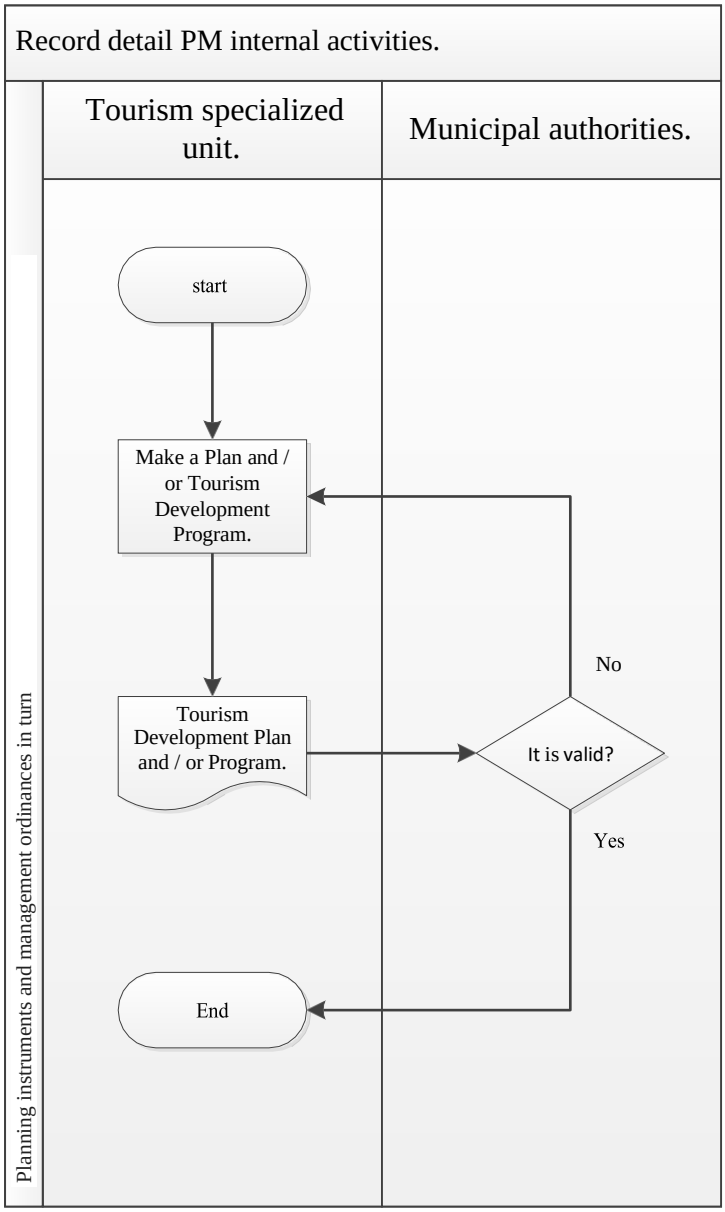


5. Instruments of Planning and ordinances of the administration in turn (in force)

f. Submit a copy of the Municipal Tourism Development Plan and / or Program, validated by the municipal authorities in which specific actions are included to promote the development of the Magic Town.This fifth and final requirement is shown in the diagram in Figure :

g.

Figure 4.10 Sequence diagram of the fifth registration requirement



The aforementioned documents have registration effect, as they are subject to validation by the Secretary of Tourism, through the Directorate General of Destination Management. If the Applicant Locations do not meet these requirements, they are not considered as magical Towns.

The process of incorporation into the Magical Towns Program (MTP) requires that the aspiring locality comply with important elements that demonstrate sustainable development, tourism and that it complies with the necessary regulations. This requires the participation of the different levels of government so that the locality, can be integrated into the MTP.In this process of incorporation into the program, you need the following elements, which are subject to analysis and validation (Ana María Huayna, 2009**).**

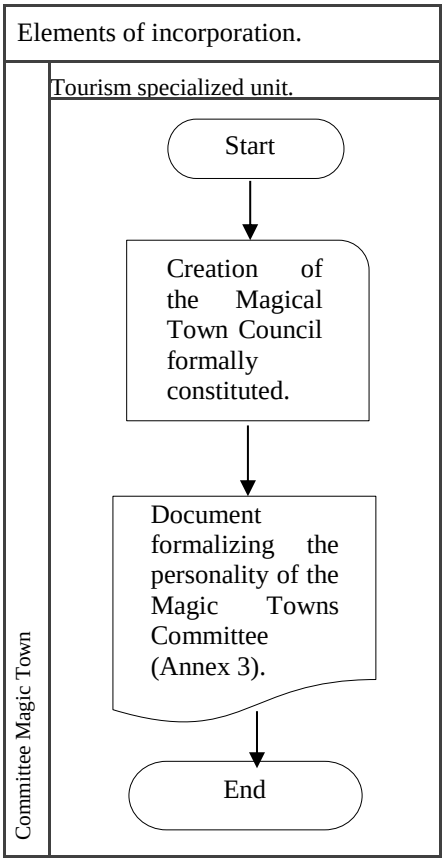
Incorporation Process

Formally constituted Pueblo Mágico Committee (Annex 3).

a. Submit a copy of the document that forms the personality of the Committee of the "Magical Town". (Present original for comparison in all cases) containing Name of the members, Work program to 5 years, Internal Regulation of operation among other things.

For the first incorporation requirement, the process is exemplified in the diagram in 4.11:

Figure 4.11 Sequence diagram of the first incorporation requirement

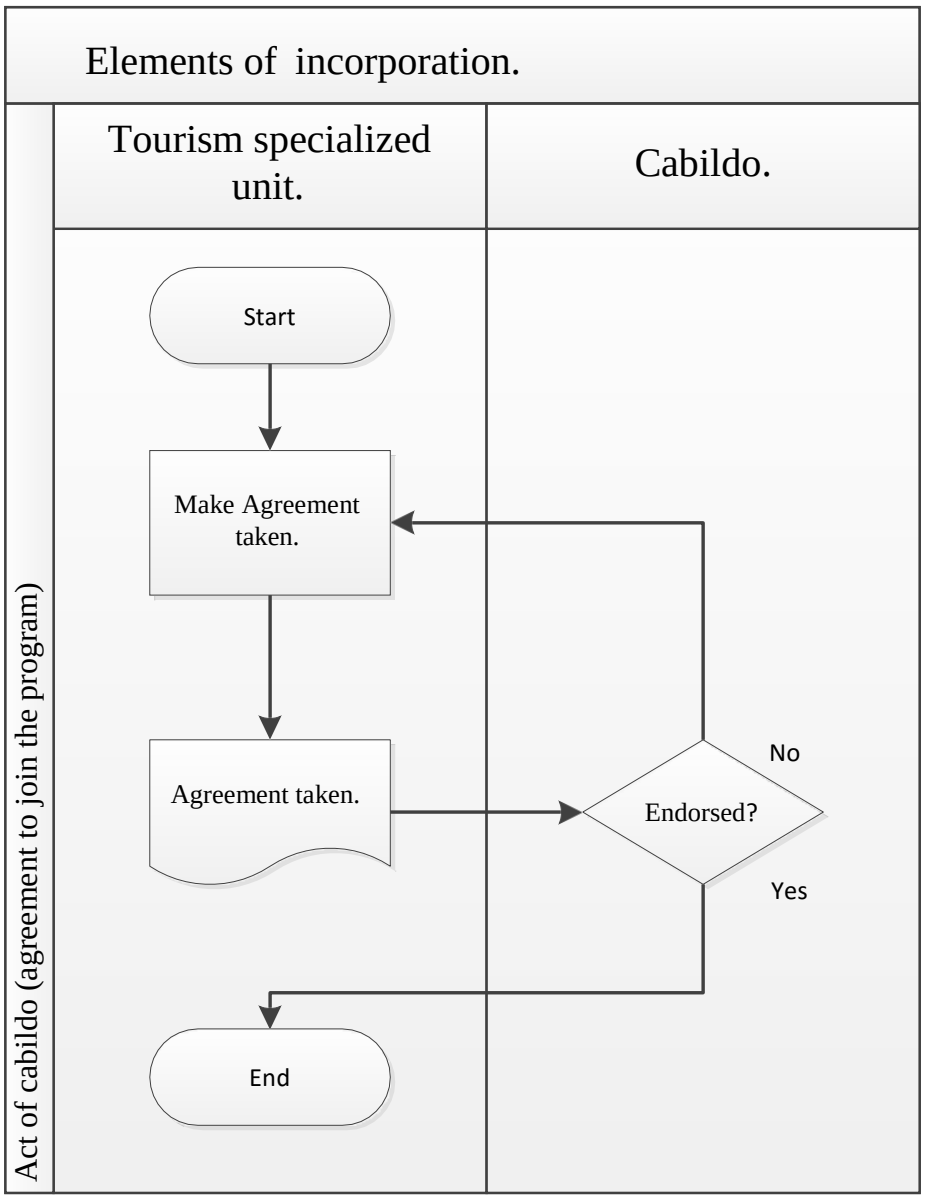


2. Minutes of the meeting (agreement to apply for membership of the Program).

a. Submit a copy of the agreement taken and endorsed by the lobby

The second requirement of incorporation, shown in

Figure 4.12 Sequence diagram of the second incorporation requirement

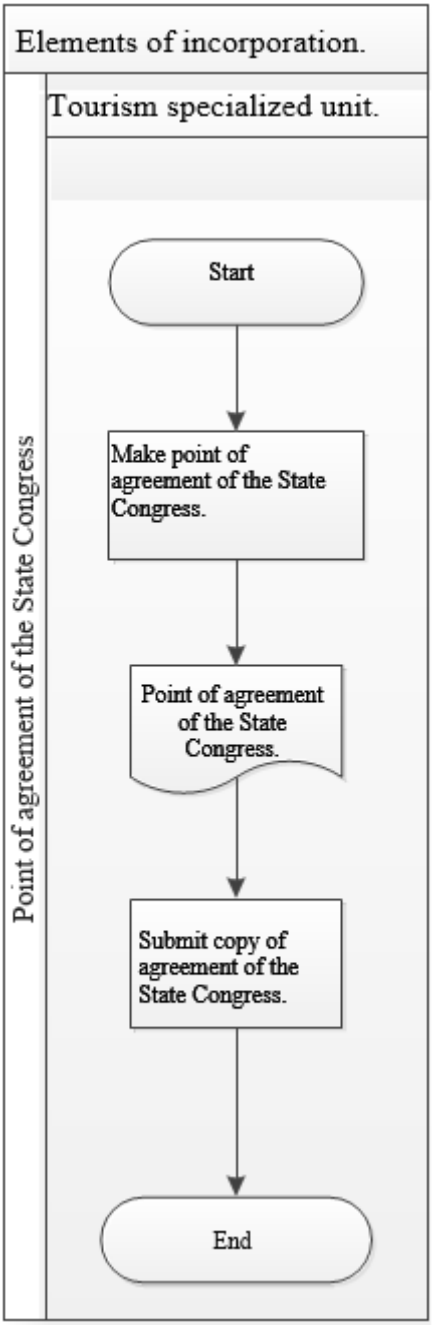


3. Point of agreement from the State Congress.

a. Submit a copy of the document in which, in addition to expressing the agreement of the State Congress for the postulant city to join the Magic Towns Program, a commitment to label an annual budget for the tourist development of the locality.

The third requirement is presented in Figure 4.13:

Figure 4.13 Sequence diagram of the third incorporation requirement

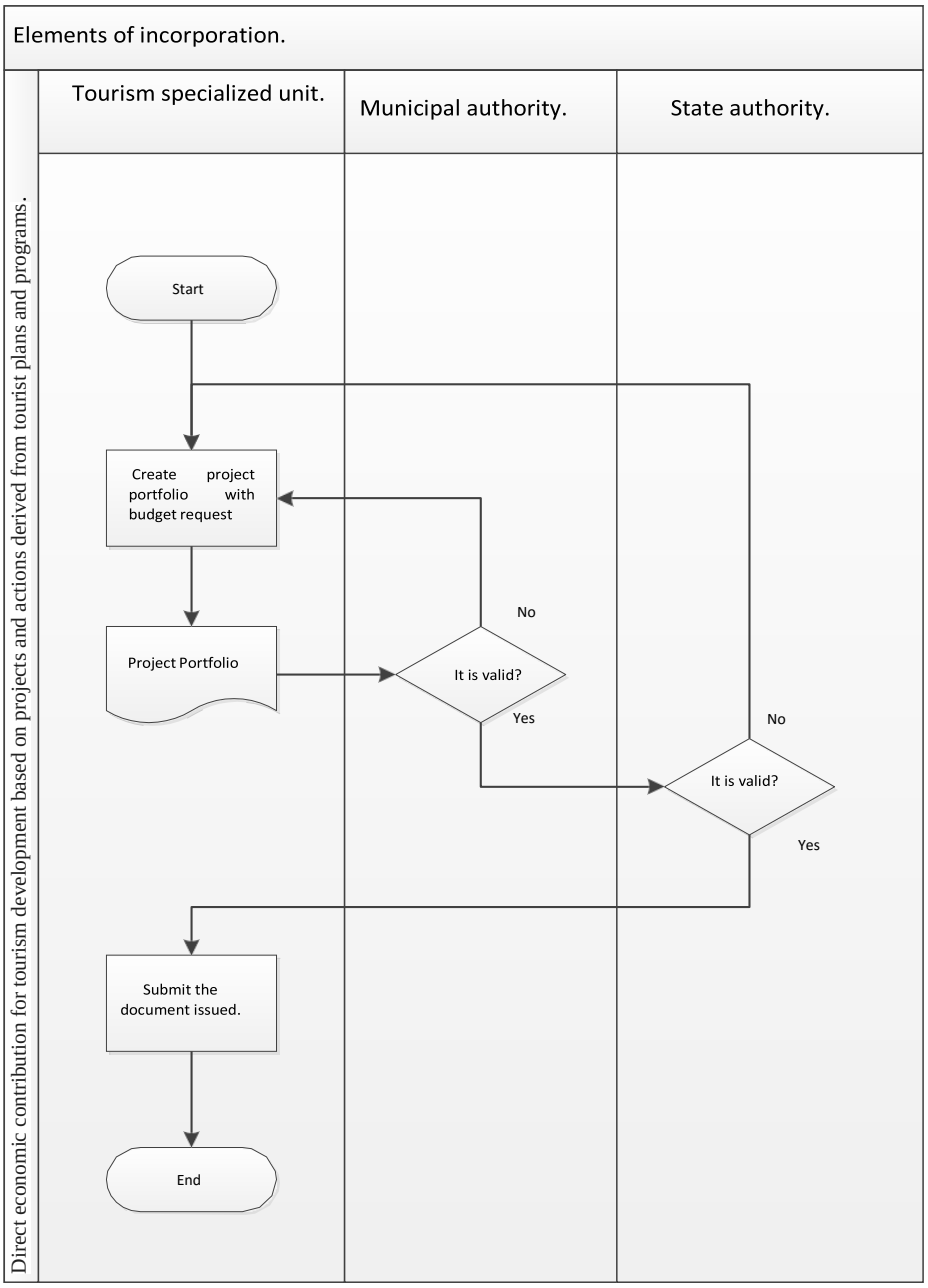


4. Direct economic contribution for tourism development based on projects and actions derived from tourist plans and programs

a. Submit the document issued by the municipal and state authority in which the commitment and annual amount of the contribution is established with its respective portfolio of projects.

The fourth requirement, shown in the diagram in Figure :

Figure 4.14 Sequence diagram of the fourth incorporation requirement

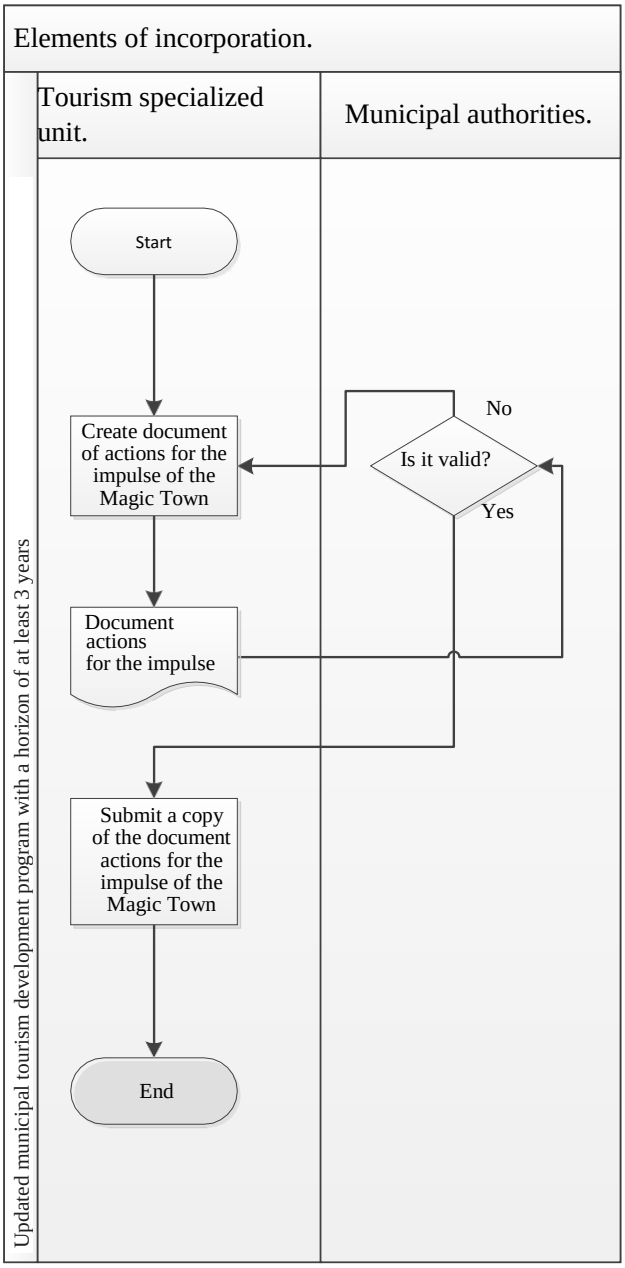


5. Updated municipal tourism development program with a horizon of at least 3 years

a. Submit a copy of the valid document, validated by the municipal authorities in which actions are established for the promotion of the Magic Town.

The fifth requirement of incorporation, is seen in,figure 4.15:

Figure 4.15 Sequence diagram of the fifth incorporation requirement



6. Updated ordinations with a tourist focus, during the current administration of the Municipality

a. Submit a copy Municipal Tourism Development Program validated by the municipal authorities.
b. Submit a copy of the Municipal Urban Development Plan, validated by the corresponding authorities.
c. Submit a copy of the Municipal Regulation of Commerce in a public area, validated by the municipal authorities.
d. Submit a copy Municipal Safety Program, validated by the municipal authorities.
e. Submit a copy of the Municipal Civil Protection Plan, validated by the municipal authorities.
f. Submit a copy of the Urban Image Regulation, validated by the municipal authorities.
g. Submit a copy of the Municipal Solid Waste Management Program, validated by the municipal authorities.

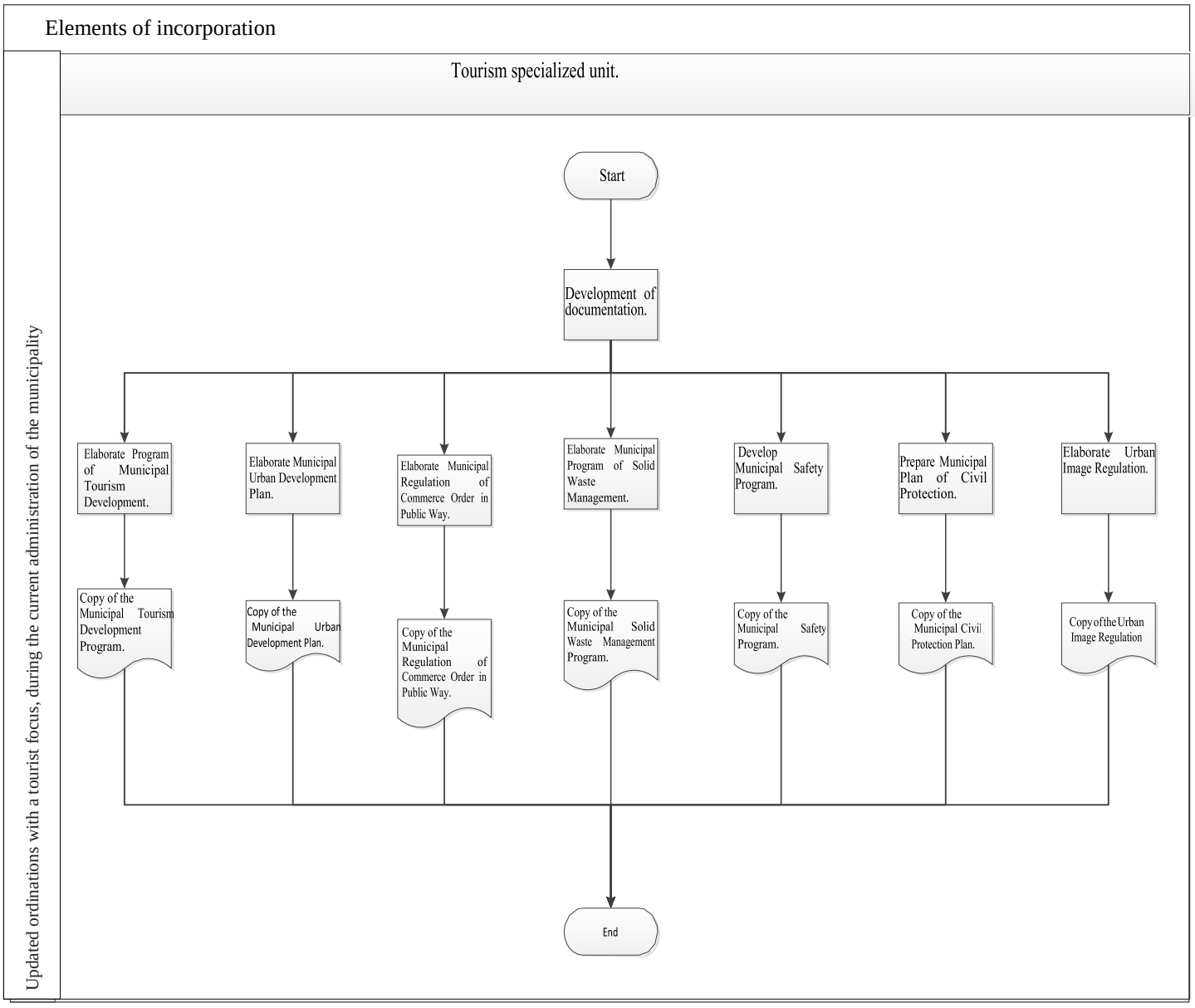
Notes:

– Actions to restrict and mitigate informal trade in areas of high concentration of visitors or in tourist areas and in the area of influence of these should not be confused with the sale of traditional products that give life to the squares And public roads.

– All programs should articulate strategies for the development of public services and tourism.

The sixth requirement is reflected in the diagram on

Figure 4.16 Sequence diagram of the sixth incorporation require



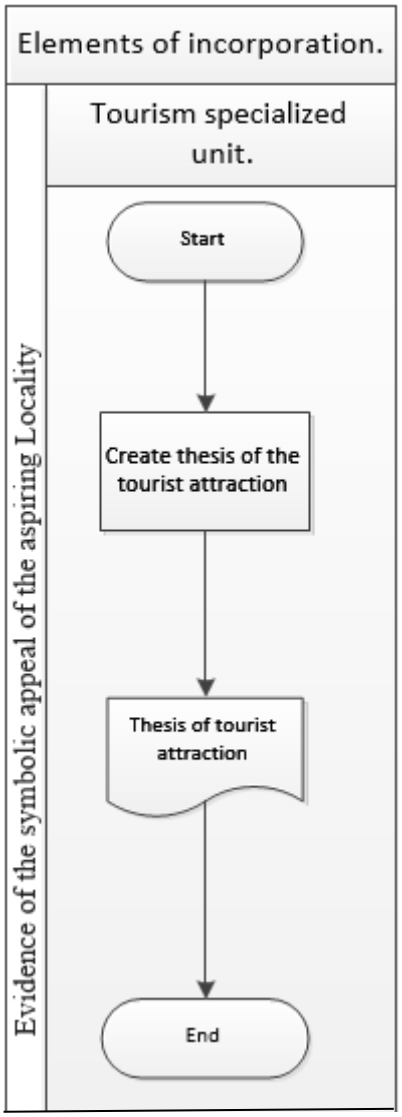
7. Evidence of the symbolic appeal of the aspiring Locality

a. Development of the thesis of the symbolic attraction or set of them, written in a document with a minimum of four pages, in which the sociocultural and / or natural attributes of the symbolic attraction or set of them are clearly expressed. It is convenient to add photographs as an attachment to the requested pages.

Note: Demonstrate in its thesis that they have a symbolic tourist attraction (unique, irreplaceable and authentic) that differentiates it from other localities in the state, region and even the country.

The seventh requirement for incorporation is shown in the diagram in Figure 4. 17 :

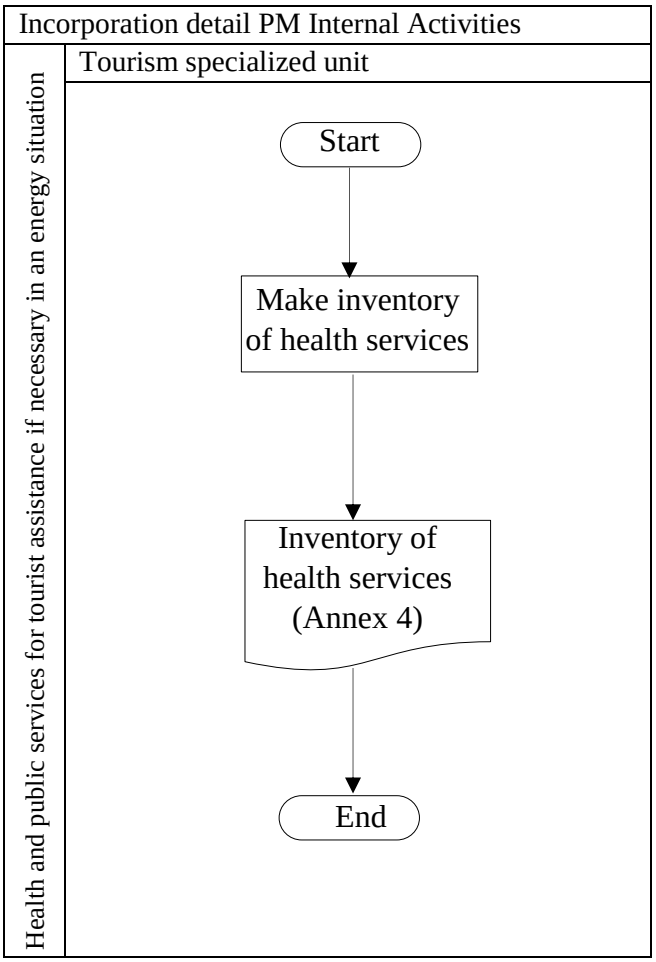
Figure 4.17 Sequence diagram of the seventh requisite of incorporation



8. Public health and safety services for tourist assistance, if necessary in an emergency situation.

a) Submit an inventory of health services (institutions, hospitals, pharmacies, clinics) with a radius of influence of not more than one hour distance-time (Annex 4).

Figure 4.18 Sequence diagram of the eighth incorporation requirement

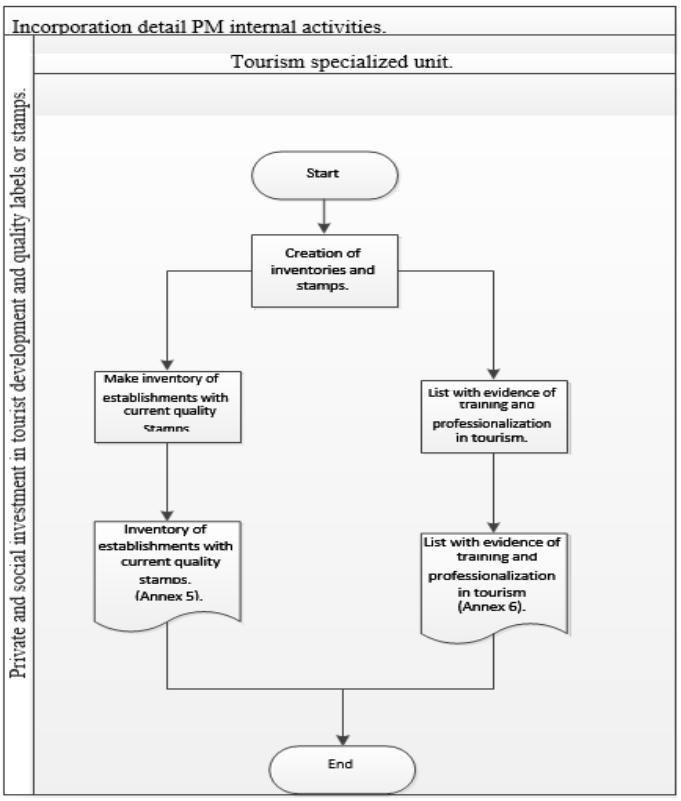


9. Private and social investment in tourist development and quality labels or stamps.

a) Present an inventory of establishments with current quality stamps (H, M and Clean Point), among others (Annex 5).
b) Submit a list with evidence of training and professionalization in tourism (Annex 6).

Ninth requirement, is exemplified in the Figure 4.19:

Figure 4.19 Sequence diagram of the 9th incorporation requirement

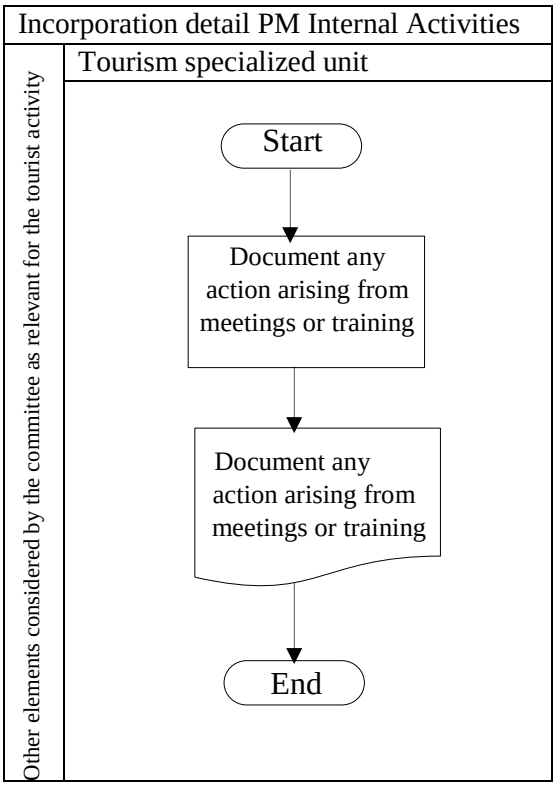


10. Other elements considered by the Committee as relevant for tourism activity

a. Any action arising from meetings or training.

Tenth and last requirement of incorporation, is shown in la Figure 4.20 :

Figure 4.20 Diagram of sequence, tenth incorporation requirement.



Process of permanence

For the permanence process the same requirements listed in the incorporation phase are obtained, with the inclusion of correcting the aspects that SECTUR creates pertinent when carrying out the corresponding evaluations, that is to say, the following requirements are also requested:

1. Maintain an active committee with follow-up agreements.
2. Approval and point of agreement of the State Congress.
2. Comply with plans, programs and regulations.
3. Strengthening and innovation of the tourist products catalog.
4. Operation and adequacy of health and safety services.
5. Evaluate the impact of tourism development.
6. Maintenance of commercial relations with at least one intermediary of tourist services.
7. Have a Statistical Information System.
8. Integrate a detailed report of activities (annual).
9. Follow up on other elements that the Committee considers relevant to the operation of the program.

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