

# The Use of UML Activity Diagrams and the *i\** Language in the Modeling of the Balanced Scorecard Implantation Process

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## ABSTRACT

Business management is a complex task that can be facilitated using different methodologies and models. One of their most relevant purposes is to align the organization strategy with the daily functioning of the organization. One of these models is the Balanced Scorecard (BSC). In this paper, we propose a modeling strategy for the BSC implantation process. We will model it using UML Activity Diagrams and Strategy Dependency models of the language *i\**. The Activity Diagrams allow determining the order in which involved activities must be performed, and at the same time, to identify which people has the responsibility to carry them out. The Strategic Dependency model allows showing the intentional aspects of the actors involved in the most strategic activities of this process. Finally, relationships among the actors and the people involved in the BSC implantation process are modelled using again the language *i\**. Although this paper only considers the case study of the BSC implantation, our proposal can be generalized to other implantation processes of systems with a high strategic impact on the organization, like ERP or CRM systems.

**Keywords:** Balanced Scorecard, Goal-Oriented Languages, Activity Diagrams.

## 1. INTRODUCTION

Different business management models have been appearing recently, most of them centered on the improvement of the organization operation, taking into account the organization strategy. Among them, it stands out the Balanced Scorecard (BSC) model developed by Robert Kaplan and David Norton [1] at the beginning of 90's. The main purpose of this model is to communicate the organizational strategy towards the different operative levels of the organization and to reflect it in the business processes.

BSC is used as a model of management, as a communication tool between different parts of the organization, and it can even be used to manage the organizational change/evolution. There are some experiences of BSC implanted in large as well as medium organizations by different consultants. Recently one of the authors has participated in the consultancy of two implantation processes in two Spanish small-to-medium enterprises. These experiences seem to point out an apparent absence of clearly and well-organized publications describing in detail the BSC Implantation Process. Although there are some publications, like [2] (developed by strategy consultants), that describe this process step by step in natural language, it is not formalized enough to be used as a prescriptive manual of the process.

The purpose of this paper is to model the Balanced Scorecard implantation process by describing its stages and activities, as well as analyzing the intentions of their participants.

The implantation process of the BSC model is sequential in nature. We use UML activity diagrams [3] to describe the involved activities and how they are grouped in stages. We select some of them that have higher strategic impact into the organization and then we model the strategic and intentional aspects of the actors involved in these activities using the goal-oriented language *i\** [4].

In section 2, we make a brief description of the BSC model. In Section 3, we show the implantation process of the BSC model using activity diagrams of UML. Section 4 describes the activities with a higher strategic impact using the language *i\**. In section 5, we analyze the relationships between different types of actors involved in the above activities. Finally, section 6 summarizes our conclusions and future work.

## 2. THE BALANCED SCORECARD

BSC is an organizational management model dating from the beginning of the nineties from the Harvard Business School and developed by Robert Kaplan and David Norton [1]. The basic principle of this management model is "*it is only possible to manage what can be measured*". Therefore, this management model consists of a framework that tries to help organizations to translate their strategy into operative terms, which are more measurable. These constitute the guidelines for the business improvement analysis, for example, the effectiveness improvement of the organizational processes. In addition, with an adequate management of the implantation process, people can adopt more strategic attitudes, and therefore improve the key processes of the organization.

BSC proposes to model the organization under four perspectives or points of view, as it is shown in Figure 1. These are the learning and growth point of view of the organization, the business process perspective, the customer point of view, and the financial perspective [7]. Moreover, in the center of the figure we show the vision and the strategy of the organization, and its influence to these perspectives. Each organizational perspective is defined in terms of four elements. These elements are:

- *Strategic objectives* that define what the organization wants to achieve.
- *Indicators* that are used to measure how much an strategic objective is achieved.
- *Goals* that are a quantitative representation of an indicator at some moment of the future.
- *Strategic initiatives* that correspond to some actions that the organization must perform to achieve an strategic objective [5].

Arrows between the organizational perspectives of the figure state some kind of relationship between the strategic objectives of these perspectives.

The implantation process begins with the (re)definition of the vision and strategy of the organization which constitutes the basis for the following steps.

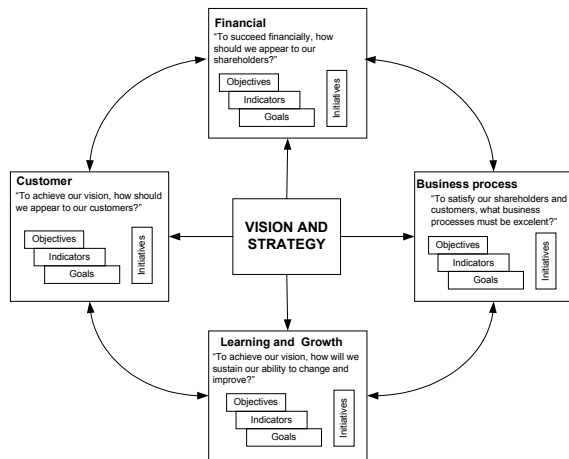


Figure 1. Strategic elements of the BSC model

Taking account this strategy and the organization perspectives, the strategic objectives are defined (e.g., “to increase the benefit”) and some indicators are associated to evaluate them quantitatively (e.g., “% benefit”, “number of satisfied customers”). Goals (e.g., “to increase the benefit by 5%”) are defined with respect to the results that should be obtained with the indicators evaluation after apply some strategic initiatives (e.g., “development of a software for the department of sales”).

Figure 2 shows the Strategic Map with the strategic objectives of the organization as a hierarchy stating how the attainment of an objective contributes to the attainment of others. In this way, to accomplish the purpose that the organization pursues, the BSC model may consider an ordering between the four perspectives based on the importance of objectives. In our example, we are considering profit organizations, where financial perspective appears in the highest level because it is the most relevant perspective in this type of organizations.

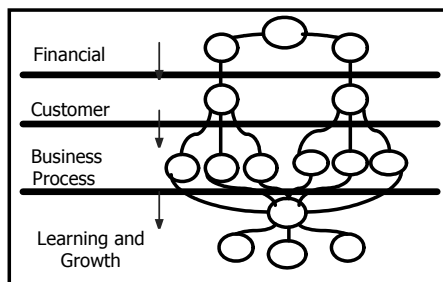


Figure 2. Strategic Map

The identification of indicators and how to associate them to the strategic objectives must be coherent with the analysis of the information available in the organization and in different types of information repositories (databases, text files, spreadsheets, etc.). These indicators depend on the objectives which they are associated to, as well as on the goals to be fulfilled. To obtain and analyze this information, other management models may be used (Activity Based Costing (ABC), Added Economic Value (EVA), Studies of Market, Total Quality Management (TQM), Empowerment, etc.). In this sense, a BSC tool may be observed as a unifying tool that manages this information in order to obtain strategic results [8].

After the identification of such elements in each perspective, strategic objectives, indicators and goals must be incorporated into the daily functioning of the

organization, by considering existing strategic initiatives and plans of work. New action plans may be defined supporting the vision and strategy of the organization. This incorporation is strongly dependant to the impact that causes the implantation of the BSC model on stakeholders.

### 3. THE USE OF UML ACTIVITY DIAGRAMS

We propose to use activity diagrams of UML to describe the activities that constitutes the implantation process of the BSC model. These diagrams allow modeling this process in a sequential, parallel and iterative way, and moreover, allow making a preliminary identification of the role that some people of the organization must play when they assume the responsibility of one of such activities. Finally, we state that this type of diagrams is adequate to model some aspects of organizations [9].

In the Figure 3 we show the activity diagram of the BSC model implantation process. In the upper part, we indicate the roles that have been identified. For clarity, we have grouped the activities involved in this process in stages shown in the left margin of the figure. These stages are the following:

#### I. Initial stage

This stage begins when the organization decides to adopt the BSC model.

**1. Diagnostic of the organization:** In this activity the manager gathers and analyses the information available in the organization (e.g., real benefits, changing laws, etc.) to identify which changes apply. This analysis may be supported by consultants. People that perform this activity must have some experience and must be familiar with the organization.

**2. Selection of the BSC team:** Managers and stakeholders design the BSC implantation team, taking into account the most adequate criteria (e.g., degree of confidence, position, knowledge of the organization, etc.). This team will lead the introduction of the BSC model into the organization.

**3. Training in BSC model:** An instructor, who use to be a BSC consultant, will train the members of the BSC team on how to implant the BSC model, its difficulties and consequences.

#### II. Strategic stage

This stage is the most important of the implantation process, since its success will determine the final quality.

**4. Formulation of the BSC model:** In this activity, the strategic elements of the BSC model are defined (vision, mission, strategy and strategic objectives). Moreover, the Strategic Map is also constructed by considering cause-effect relationships between objectives. After defining the strategic elements, we obtain an initial version of the BSC model. This model is translated to operational terms by assigning to each objective a set of indicators.

**5. Distribution of responsibilities:** A subset of the BSC team is selected to be responsible of the strategic elements. They must ensure that their initial definition is correct, adequate and that they model the organization reality.

**6. Selection of strategic indicators:** Once the strategic elements are established, some indicators are associated to the strategic objectives. These indicators must represent the best way to measure an objective, they can be evaluated periodically using well-defined metrics (units, correct values, ranks of values, ...).

**III. Incorporation of information technology stage**

In this stage, we group all the activities involved in information technologies. For example, deciding whether or not to acquire support tools to aid during the BSC implantation process. In this case, notice that as the implantation process goes on, the role of a BSC software tool changes: at the early stages, BSC software is used as a communication tool; in the following stages, it is used as an evaluation tool; and, when the BSC model is more successfully adopted in the organization, it is used as a strategic management tool.

**7. Determination of the most adequate BSC software:** Members of the BSC team that participate as strategists in this process will require some external support to evaluate and select alternative BSC software products offered by the market. Moreover, it is even more important to evaluate the interoperability between this software and the already existing enterprise information systems of the organization.

**8. Incorporation of the BSC model:** Once the BSC software is selected and installed, users of the system will introduce the information of the BSC elements (objectives, indicators, ...).

**9. Manual loading of indicators data:** The users of the BSC software introduce manually or by files (text, spreadsheets, etc.) information of indicators that is not in the enterprise information systems. If this information has a noticeable strategic nature, it would be desirable to store it in the enterprise information systems of the organization.

**10. Automatic loading of indicators data:** A responsible of the Information Systems department connects the BSC software to the enterprise information systems to automatically load the indicators data.

**IV. Analysis of results stage**

The analysis of the results of indicators and the actions plans allow us to evaluate whether the business processes successfully contribute to the organizational strategy and whether strategic objectives have been attained or not.

**11. Indicators Analysis:** The analysis of indicators is performed regularly depending on its periodicity. This analysis may determine that:

- Indicator is not adequate: The indicator does not measure in fact its associated objective. Therefore, a new indicator must be selected for it.
- Indicator is adequate: The indicator is adequate, but its value states that processes feeding it could require some improvements to attain the associated objective.

This continuous indicator analysis allows fitting these indicators to objectives according to the organizational changes.

**12. Strategic initiatives analysis:** Strategic initiatives use to be materialized into projects to develop. In many cases, these are isolated projects in specific departments that are not aligned with the global organizational strategy. Therefore, it is necessary to analyze and to re-plan the already existing initiatives according to the obtained indicators and their objectives. In this way, we identify which department performs it and which part of the organizational strategy it solves.

**V. Operational incorporation stage**

In this stage the organizational strategy is tried to be made operative. The organizational strategy is translated into action plans that are incorporated to the business operative processes and people.

**13. Creation of action plans:** According to the results of the previous analysis, some proposals arise to align business process to the organizational strategy. Therefore, the strategy alignment is performed in an incremental way. These proposals consist to define new action plans with its schedule and responsible.

**14. Prioritization of action plans:** According to the organizational strategy and the available resources the action plans are also prioritized.

**15. Execution of action plans:** After executing the proposed action plans, some information is obtained. The analysis of the indicators and the external variables that determine the organizational operation may require to reformulate and to adapt the BSC model to the organization. Therefore, as it is shown in Figure 3, the BSC implantation process must be modeled as an iterative process. This iteration allow incrementally adapting the BSC model to the organization.

**4. MODELLING INTENTIONAL ASPECTS OF ACTIVITIES WITH *i\****

As mentioned above, we use the goal-oriented language *i\** to analyze and to model the intentional and strategic aspects of the BSC implantation process.

In fact, we have analyzed in Table 1 the strategic impact and how much generalizable are the activities involved in this process. The first criterion is based on our knowledge acquired in some previous experiences of BSC implantation projects. With respect to the second one, for each activity we have considered if it is possible to generalize and reuse it to any kind of organization. This criterion is important because there are activities whose fulfillment directly depends on specific characteristics of the organization in which the BSC must be implanted, and therefore, not much generalizable.

The activities that simultaneously satisfy both criteria in a full degree are indicated in grey, and for some of them we have modeled its intentional and strategic aspects.

Stage	Activity	Strategic Impact	Generalizable
I. Initial	1. Diagnostic of organization	High	Much
	2. Selection of BSC team	Low	Not much
	3. Training in BSC model	High	Much
II. Strategic	4. Formulation BSC model	High	Much
	5. Distribution of respons.	Medium	Not much
	6. Selection indicators	High	Not much
III. IT incorporation	7. Determination BSC sw.	High	Much
	8. Incorporation BSC model	High	Much
	9. Manual data loading	Medium	Not much
	10. Automatic data loading	High	Not much
IV. Analysis results	11. Indicators analysis	High	Not much
	12. Strategic initiatives analysis	High	Not much
V. Operational incorporation	13. Creation action plans	High	Not much
	14. Prioritization action plans	High	Not much
	15. Execution action plans	High	Not much

**Table 1.** Strategic impact and generalization of activities

We take advantage of the expressive power of the *i\** language to model the actors (roles, positions...) who carry out activities; the dependencies between these actors; the achieved objectives; the involved resources and some non-functional aspects.

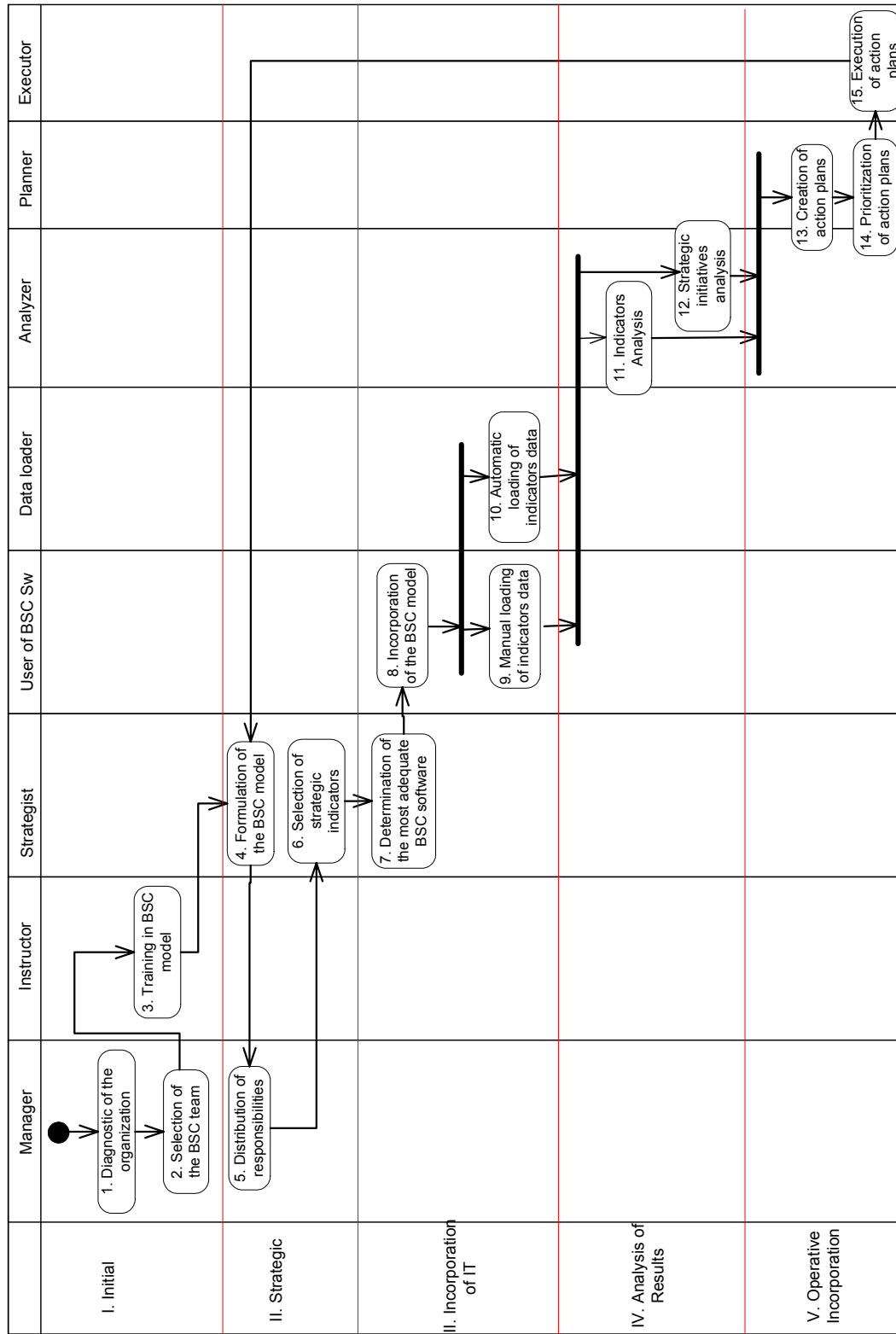


Figure 3. Activity Diagram of the Balanced Scorecard Implementation Process

Name	Definition
Diagnostic of the organization	Search & analyze information to identify which changes must be applied to the organization.
Description	
<p>The diagnostic person depends on the consultant to receive suggestions and some aid to determine which information is more adequate to analyze for the diagnosis. This information must have a suitable quality and must be obtained from the informational base (part of the enterprise information systems). From the point of view of the business, it depends on that the diagnostic person makes a diagnostic, as well as her/his suitable capacity of diagnosis.</p>	

Template 1. Diagnostic of the organization

Name	Definition
Training in BSC model	Participants must acquire a wide knowledge on the implantation and definition of a BSC model.
Description	
<p>The instructor personalizes the qualification that he/she will provide depending on the profile of the human part of the organization. The executives who are part of BSC team depend on the Instructor to receive the qualification in BSC. To make this training the best possible, the Instructor depends on how much the executives are and the executive depends on the pedagogical capacity of the instructor.</p>	

Template 2. Training in BSC model

Name	Definition
Formulation of the BSC model	Definition of the strategic elements and the Strategic Map of the BSC model.
Description	
<p>The strategist requires that the BSC consultancy is the most efficient possible. The organization depends on the strategist to reach a BSC model. In order to define the elements of the BSC model (mission, vision, strategy, objectives ... of the organization), the strategist depends on the existing business activities, on how the business is seen, and how is the organization structured. The organization depends on the ability of the strategist to formulate a good model BSC, based on the suitable capacity of strategic abstraction and its organizational knowledge.</p>	

Template 3. Formulation of the BSC model

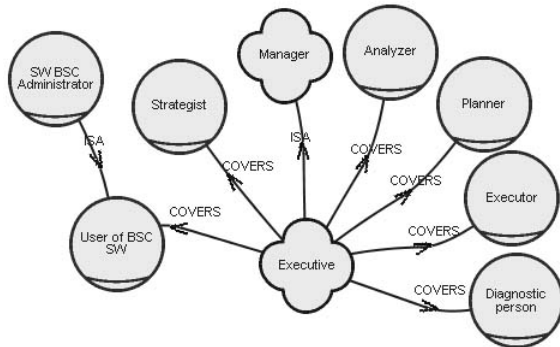
Name	Definition
Incorporating the BSC model to the software	Model BSC will be formulated up to a software tool that facilitates to communicate the strategy to the organization.
Description	
<p>Users of the BSC software depend of the executives to choose the team in charge that will update the model. This team must be designed suitably since it will be fundamental for all the process. The users of BSC software depend on the executives so that a BSC model near the reality is provided to them. BSC software depends on the users so they introduce information of the BSC model and they build the strategic map. For a suitable construction of the strategic map, the BSC software must have possible most efficient the graphical capacity, besides to provide privacy of the data to the organization.</p>	

Template 4. Incorporating the BSC model to the software

**5. ACTOR RELATIONSHIPS**

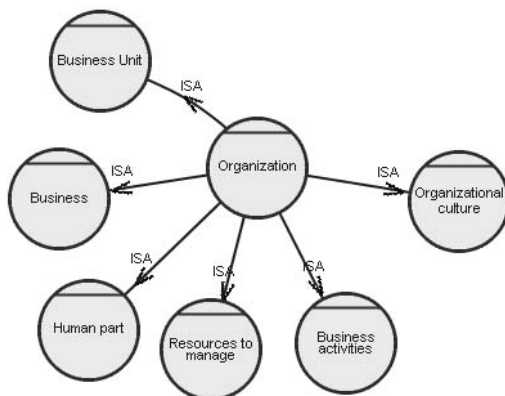
In the activity diagrams of section 3, we have identified people responsible to carry out some activities. This people correspond to roles and positions identified in section 4. However, we have identified also additional positions, roles and agents not present in section 3. In this section, we analyze in more detail relationships between the actors involved in the BSC implantation process.

Figure 4 shows different types of actors identified in the activity diagrams and the *i\** models. Relationships between them can be described using the *i\** notation. For example, the consultant (agent) “plays” the role of instructor, meanwhile the IT department “plays” the role of data loader. On the other hand, the executive position “covers” different roles: analyzer, planner, etc.



**Figure 4.** Actor relationships

Some of the actors identified in the *i\** diagrams model abstract organizational aspects difficult to classify, since it is difficult to establish what kind of *i\** actor they correspond. This situation appears when the same actor can be interpreted under different points of view. For example, the organization can be seen as a business, as a business unit, as the organizational culture, or as a resource to manage. On the other hand, it is not strange to refer in the same diagram to some of these different interpretations, see for example the *i\** model of the activity “Formulation of the BSC model” in template 3. In this sense, we propose to model these abstract actors as agents and to use an *is-a* relationship to specify its different interpretations (see fig. 5). We use an *is-a* relationship instead of *part-of* because we do not consider here the abstract actor as a composition or aggregation.



**Figure 5.** Abstract actors relationships

**6. CONCLUSIONS**

The strategy of combining UML activity diagrams UML with the *i\** language can be useful to model complex processes. In this paper, we have considered the Balanced Scorecard management model implantation process since it has a high and strategic organizational impact.

UML activity diagrams have been used due to their standardization and its high potential of abstraction, and because it allows describing a complex implantation process in a sequential, precise and comprehensive way. Combining activity diagrams and *i\** models makes possible to delimit more clearly business process flows; as well as to identify the process participants. These participants are analyzed first to identify their roles as people responsible to carry out activities, and later, by considering its intentionality in each activity.

We have identified some difficulties in the representation of relationships between different interpretations or abstractions of organizational and information systems actors. In this sense, we propose to model these relationships under different points of view and to use the *is-a* constructor.

The exercise of modeling presented in this paper will be useful to explore in the future the potential advantages of combining activities diagrams and *i\** models in the complex processes modeling.

Moreover, the use of the patterns or templates as we have proposed in section 4 must be explored as information compilation tools and modeling aid tools.

**7. ACKNOWLEDGEMENTS**

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