

# **Creating a Decision Support System for Service Classification and Assignment through Optimization**

*Emergent Research Forum Paper*

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## **Abstract**

This paper explores the creation of a Decision Support System (DSS) for the classification and assignment of support tickets within an Information Technology Service (ITS) organization. With a reliance on lower-skilled, outsourced, or temporary workers, many organizations service desks experience issues with processing of incoming support tickets. Beyond this, these workers require extensive training and functional knowledge of the company's structure, and service offerings in order to effectively process tickets. Training requirements, misassignment, unnecessary escalations, and low confidence all contribute to increased costs in the ITS organization. The DSS leverages optimization methods, machine learning, and historic data in order to match an incoming tickets to a service within a service catalog, and recommends an appropriate assignment to a team or individual within the ITS organization for fulfillment or resolution. With this system, a front-line worker gains confidence in the assignment and classification, with lower training barriers and sunk-costs.

## **Keywords**

Service Experience, Service Optimization, Assignment Optimization, Decision Support Systems.

## **Introduction**

The role of the front-line technician in an Information Technology Service (ITS) organization requires detailed knowledge of the structure of the organization, as well as extensive knowledge of all of the services that the ITS organization offers. To complicate this role further, this tier-1 worker tends to be less-skilled, temporary or, increasingly, outsourced to a third-party company (Grupe 2000). Beyond this, trends in outsourcing show many outsourced call-centers are providing support for multiple organizations concurrently (Overby 2016). All of this together means that high knowledge expectations are being placed on a low-skill role, which can lead to many problems for an ITS Organization. Together, these problems contribute to issues with consistency, and increased costs for the organization. In this paper we look at an IT Organization supporting a north-east mid-sized University as a case study, and analyze these problems to explore the creation of a decision support system to help mitigate some of these risks, conserve resources, and decrease the costs for the processing of incoming service desk tickets.

## **Background and Key Terminology**

Prior work in IT service delivery, process improvements and optimization, have been restricted to their own domains. A systematic search for related works include extensive modeling, and process documentation for industry best practices and theory. In this section, we explore prior works and existing theory and modeling to support the construction of the proposed decision support system. In doing so, key concepts and terminology from that foundation are discussed.

## User and Technician

A major goal of information systems is to assist people in completing their tasks and achieving their goals (Cummings et al. 2013). Two important group of people in our proposed Decision Support model are users and technicians. A user is the person submitting the ITS support ticket, or the person for whom a ticket should be processed. Whereas a technician is the person, usually *within* the ITS organization, who will be processing and/or fulfilling that support ticket.

## Service & Service Catalog

A service is a “means of delivering value to customers by facilitating outcomes customers want to achieve without the ownership of specific costs and risks” (Carlidge et al. 2007; Van Bon et al. 2008). Simply, this is something which an ITS organization provides for their users.

A Service Catalog is the collection of all services which an ITS organization offers organized into a taxonomy or hierarchy based on groupings. These groupings typically start with a broad Service, and gain specificity with a defined category then subcategory. A service catalog can be thought of as a menu of services, offered by the ITS Organization, to users.



Figure 1. Service Catalog Taxonomy Example

## Tickets, Incidents and Requests

For our purposes, a ticket is both the abstract and literal representation of an end-users submitted incident or request. An incident is a report of something not working (e.g. “my PC keeps crashing”), or not functioning as intended, whereas as service request is the user asking for a service to be provisioned (e.g. “I need access to a shared drive”)(Carlidge et al. 2007; Van Bon et al. 2008).

## The Current Process

In the ITS Management Incident Request Model (Van Bon et al. 2008), as used by the examined organization, a user submits a ticket to a Service Desk (or Help desk) where it then processed by a Tier-1 technician. That technician must extract meaningful value from the customer’s description of their issue, and try to classify the ticket to match with a service offering within the ITS Organization’s service catalog. More than likely, that technician asks their peers or managers for assistance in processing the ticket. After classification, ideally, that technician then fulfills and resolves the ticket. In most cases however, the technician assigns the ticket to another support team or escalates the ticket to a higher tier technician.

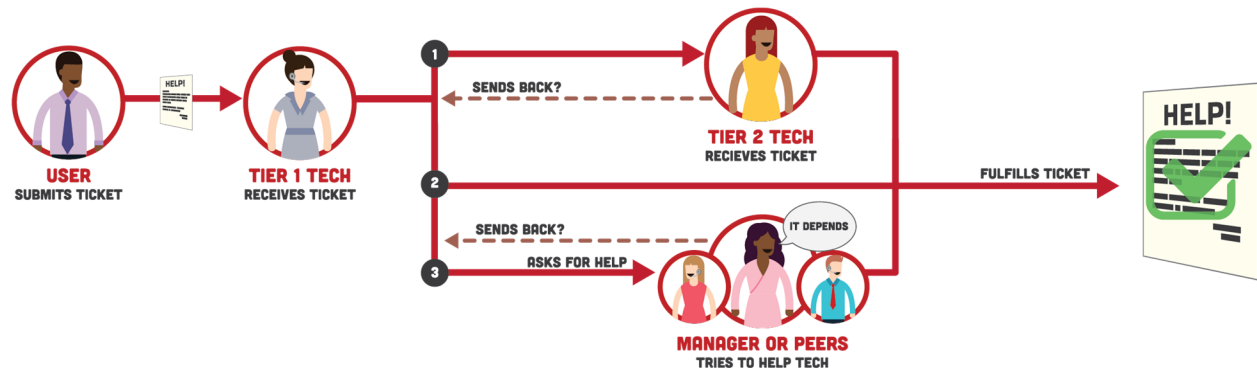


Figure 2. The Current Incident Response Process

## Problems with the Current Process

The current model for ticket processing has several main problems, which, together, contribute to resource waste and increased costs.

## ***Training Requirements***

In order to understand how to assign or classify a ticket, a tier-1 technician must understand every possible service that the company offers within its catalog. Additionally, that technician needs to be familiar with the organizational structure of the ITS organization, in order to appropriately route escalations. This requires extensive upfront investment in terms of training and knowledge documentation on the part of the ITS organization. In the examined organization, the tier-1 staff is made up primarily of student workers, who work between 6-12 hours a week, with a high turnover. With this in mind thorough and comprehensive training proves difficult.

## ***Tribal Knowledge***

When properly implemented, knowledge management has major positive impacts on a business (Darroch 2005). Knowledge creation is costly, which means many times knowledge is not captured and documented, leading to hindered knowledge transfer (Buckley and Carter 2000). There are times when knowledge is contained within a team or individual and not readily accessible. This “tribal knowledge” limits the spread of information, and in the case of IT ticket processing, can affect the classification and assignment of a ticket. This is especially problematic with a workforce in flux, as things learned may not always be documented properly for sharing (Collins 2016).

## ***Historic Data***

Once resolved historic ticket data is used in aggregate to establish metrics, gather statistics, and create key performance indicators. However, much of the per-ticket data about the assignment and classification process is underleveraged, especially in informing the handling of incoming tickets.

## ***Consistency***

Because there are multiple tier-1 technicians, and the process of assignment and classification relies on training, tribal knowledge, and does not make use of historic data the handling of each incoming ticket is variable and inconsistent. Because of this, a ticket submitted to the Service Desk will most likely not receive the same classification and assignment in a repeatable manner.

## ***Costly Escalations***

In ITS escalations are costly, and with each escalation from tier-1 through tier-n that cost increases. This cost is called the total cost of ownership (TCO), and represents the total cost end-to-end of handling a request or incident (Rumburg 2011). Tickets that could be resolved at tier-1, but end up escalated or tickets that require moving around amongst peers, end up increasing the TCO.

## ***Cherry-Picking***

When examining ticketing process at the case organization, it was observed that the technicians were not working on tickets in order of priority, or first-come-first-served, but rather, manually choosing which tickets to work on. Technicians favor tickets that include simpler services. This means that more advanced technicians were working on tasks that may have been below their skillset, while some more closely matched or complicated tickets would sit unprocessed.

## ***Alternate Solutions***

Many of the problems listed previously can be addressed individually, or with other system implementations. If issues like costs and employee turnover are not a concern, a company could invest extensively in training to mitigate many of the issues with consistency, and minimize escalations. Skilled managers or strict technology changes could diminish the impact of cherry-picking and add oversight to reduce incorrect escalations. An extensive and easy to navigate knowledge base could help with several of these problems. However, these options are typically costly, change workflows, or require unrealistic

expectations on employees. The proposed solution in this paper addresses all of the above problems, with minimal impact on workflow, and serves to enhance in-place processes rather than replace them.

## Proposed Solution

To address the above stated problems, we propose a decision support system that makes use of machine learning, historic data, and optimization methods. This system processes incoming tickets and provides a recommendation to the tier-1 technician for how to classify and assign the ticket. This recommendation helps to instill confidence in the technician, and expedites the ticketing process, leading to cost savings for the ITS Organization.

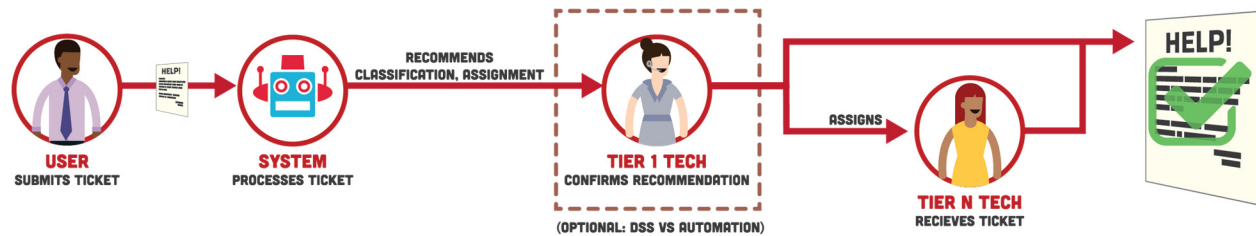


Figure 3. Proposed Incident Response Process

## System Processing

The decision support system provides its recommendations to the technician based on a three stage processing. The first step in processing an incoming ticket is to extract the keywords from the ticket via machine learning. Once extracted, the incoming keywords are matched to a service within the service catalog. With the corresponding service known, the system can then propose a best-fit assignment to a technician based on the skills required to fulfill the service, and the skills, cost, and availability that the technicians have. The system is able to propose a best match that the tier-1 technician can leverage to support their decision-making process when assigning and classifying tickets.

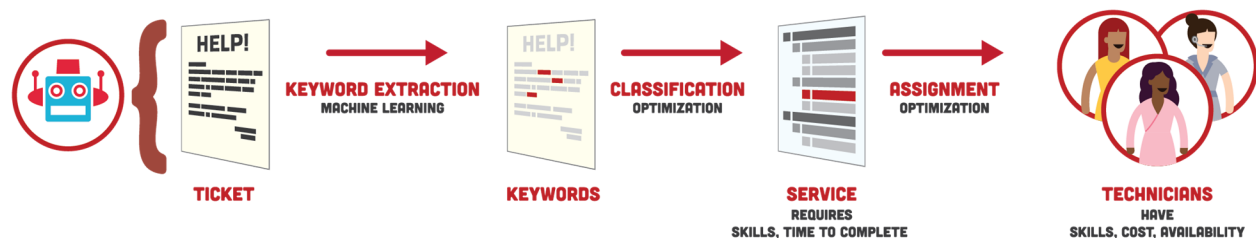


Figure 4. System Processing of the DSS

### Stage 1: Keyword Extraction

Using natural language processing through machine learning we are able to extract the keywords from an incoming support ticket. This requires finding not only the keywords of the body, but removing extraneous information such as greetings, headers, and signatures.

### Stage 2: Classification Optimization

The classification phase maps the extracted keywords to the ITS organization's service catalog using optimization methods and historic data. Keywords are extracted from the historic data learning set, wherein the frequency of those keywords is mapped to the given service that those historic tickets were classified to. The closest fit can then be proposed as a classification candidate within the DSS.

### Stage 3: Assignment Optimization

With a known classification, the system then finds the best match for the ticket's service to the technician that can optimally fulfill the ticket. A variation of the generalized assignment problem (Cohen et al. 2006; Shmoys and Tardos 1993) is used to recommend the best candidate to fulfill each ticket. This optimization takes the required skills and time to fulfill a given service request as vectors and maps them to the technician's skillset, cost, and availability vectors. The optimization takes into account this best fit, and assigns a task that is the closest fit to the technician or team. This means that it takes into account not only the minimum skill threshold required to complete a ticket, but penalizes for going over the required skill. Therefore, the person or team with the closest match to the requirements will be the one that the system recommends for assignment.

### Conclusion

The decision support system helps to mitigate nearly every one of the six problems outlined earlier. The system reduces training requirements and decreases reliance on tribal knowledge by helping to increase the availability of information to the technician. It uses historic data to its fullest extent, and can constantly be improved as new data is input into the model. As a whole, this leads to more consistent handling of requests, and has potential to reduce unnecessary escalations while preventing technician cherry-picking of requests based on the support recommendations that the DSS provides. Reductions and mitigations of these six problems result in less resource waste across the board, and cost savings for the business because of this. By leveraging existing data and this DSS, the TCO for each request approaches a minimized amount.

With the system and optimization equations modeled, the next steps include validating the system with simulation data as well as operational data from the case organization. The output from the simulation and case study will be used to refine the model, and quantify resource and cost savings of implementing the system in the target organization.

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