

Information is the Key to Management Knowledge

by Mark Schmidt

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If given a choice of making management decisions on the basis of average information, or on the basis of specific, detailed information, which option would you choose? It is a fairly safe bet that nearly all of us would choose the latter option, simply because it offers greater potential to make more knowledgeable and productive decisions.

Information is often stated to be the key to knowledge. This adage certainly holds true in golf course management, as many decisions are based around a complex system, containing many different variables. Such conditions make it imperative that a site manager have as much information as possible to characterize and understand the intricacies involved in managing a golf course.

Information and knowledge about a site are the most important weapons a site manager can have in formulating, and execut-

ing, management decisions. More knowledgeable decisions generally afford added efficiency and effectiveness—two ultimate goals of any management operation. Both are gained through experience and a systematic process of data collection, analysis, and the integration of data with knowledge.

SITE-SPECIFIC MANAGEMENT

A new management philosophy that centers on detailed site information and the systematic implementation of data collection, analysis, data in addition to knowledge, and data-founded applications, is site-specific man-

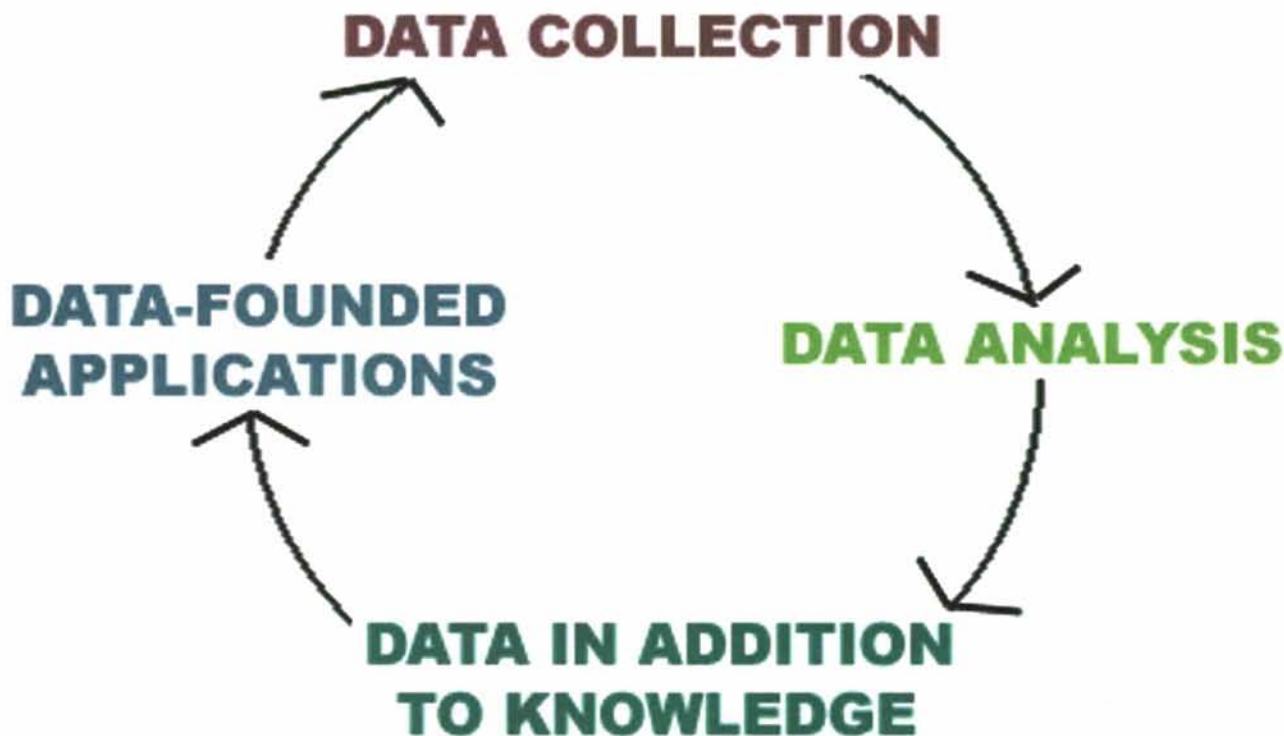


Figure 1. Systematic Site-Specific Management Process¹

agement (SSM). It promotes management decisions on the basis of specific knowledge about a site and is founded on the idea that every golf course contains variability, or differences in plant and soil characteristics. Such variances may exist in both horizontal and vertical dimensions.

Accordingly, site-specific management addresses the individual requirements of a site, produced by such 'spatial variances.' This is in contrast to conventional management techniques that derive treatments on the basis of a site's highest, lowest or average needs. In this manner, conventional management techniques do not account for specific spatial variances.

A key advantage in gaining specific knowledge about spatial variances is that it allows management decisions, and subsequent treatments, to account for the exact needs of a site. Managing specific needs allows matching inputs and treatments to specific site needs so that management efficiencies and effectiveness are maximized, from both economic and environmental standpoints. By collecting information about individual areas, and then continuously monitoring those sites, a superintendent may build a database focused on a site's responses to changes in its environment due to management treatments. A superintendent may then analyze the data and build a foundation of management decisions around those conditions.

Site-specific management relies heavily on technology as a means of implementing its concepts and strategies. Key technologies include global positioning systems (GPS), geographic information systems (GIS), electronic sensors, computers, machine control systems and others.

Site-specific management strategies promote proactive, instead of reactive, decision-making processes. Through proactive decisions, SSM works not only to increase management effectiveness and efficiency, but also to promote land stewardship and sustainability. It will undoubtedly play a key role in allowing golf courses to meet increasing economic and environmental pressures, without compromising site quality and conditions.

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Management System

Site-specific management strategies revolve around a systematic process of data collection, analysis, data in addition to knowledge and data-founded applications. The process is continuous and progressive. Because each step builds upon other steps, with no one step being all-inclusive, site-specific management is truly an integrated management system. Its systematic steps comprise its greatest advantage, in that the integration and practice of all steps work towards a common goal of increasing management efficiency and effectiveness.

Applications

If we characterize site-specific management as a true system, then we must also consider that it is not one-dimensional and that its principles may be applied in areas other than just agronomic management. It can be used to manage an equipment fleet, personnel, material inventory, irrigation and many other areas. With an underlying principle that, through the collection, analysis and application of detailed information, we can promote increased management efficiency and effectiveness, it holds a wide and diverse range of applications. Ultimately, site-specific management offers its greatest advantages to any operation when it is implemented across multiple applications as part of a comprehensive management system.

The range of application for site-specific management is substantial in that many superintendents already utilize site-specific management concepts in many aspects of their management operation, even though they may not classify such operations in that manner. The realization of site-specific management concepts may be as simple as gathering detailed information about a specific area of a site or as complex as working towards understanding inherent complexities in any management operation through historical data analysis or modeling. Despite the application, goals remain the same in working to promote management efficiency and effectiveness, from both economic and environmental standpoints.

DATA COLLECTION

Because site-specific management is based on advanced management concepts, and executed through various technologies, there is often a tendency to classify it as a tool that may only be used in

(continued on page 8)

Information Is The Key . . .

(continued from page 7)

the future once many different technologies have been assembled, integrated and developed. This idea is not accurate in that there are many ways that a golf course superintendent can presently implement site-specific management ideologies.

The most logical and practical method of implementing site-specific management starts with data collection. Collecting specific data about a site allows the ability to log and characterize existing conditions both as a means of managing current conditions as well as predicting future conditions. In this manner, data may be used to make instantaneous management decisions or to build a site history and determine management trends and site responses.

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A site history allows the identification of trends, site responses to given treatments and the ability to characterize the complexities of management operations. Characterization allows decision-making capabilities. Through historical records, a site manager can better understand the effectiveness and efficiency of past management operations in the context of present and future site responses.

Methods

Several methods exist through which data may be collected. In its simplest form, data can be collected through visual identification and manual record-keeping. More advanced methods of data collection are accomplished through the use of global positioning systems (GPS), electronic sensors and other automated tools. One might consider the ultimate means of data

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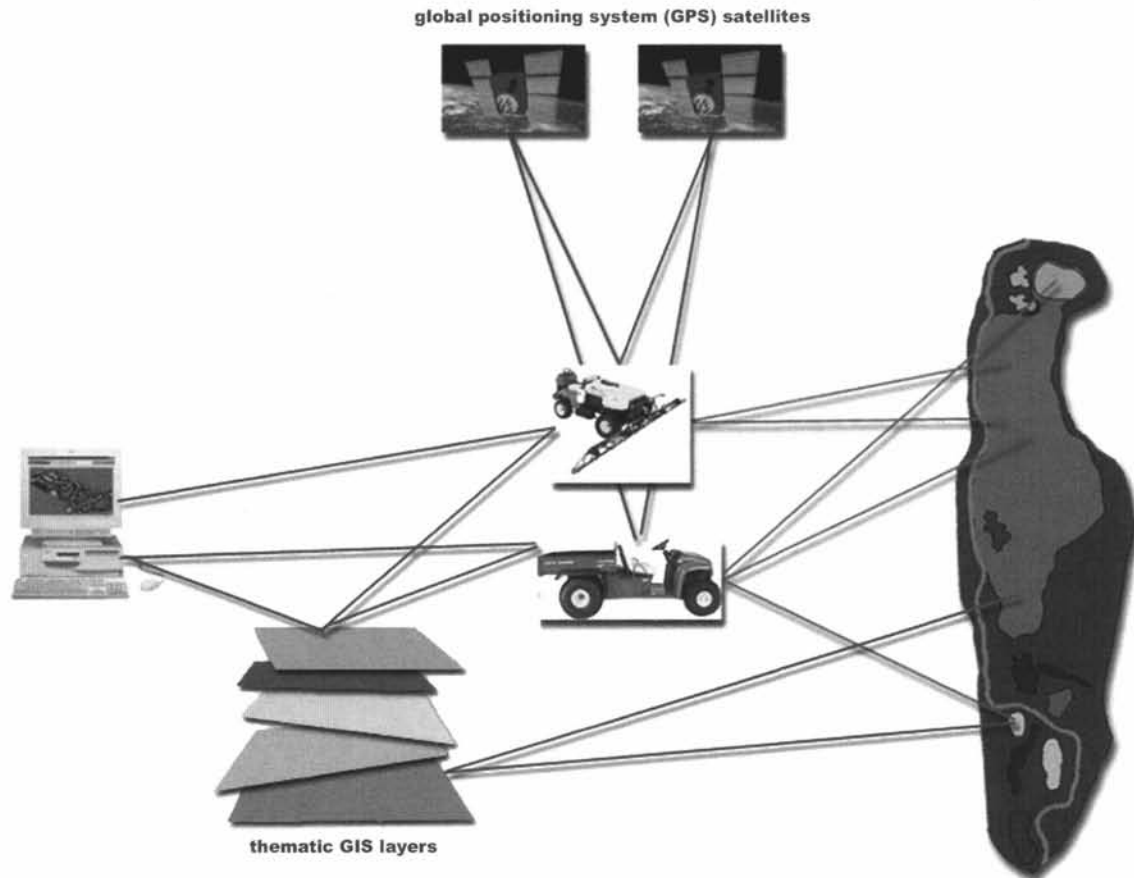


Figure 2. Interrelationships Between Site Data, Technology and Equipment

Information Is The Key . . .

(continued from page 8)

collection to be real-time data acquisition systems that collect geo-referenced data by using sensors and automated machine controls.

At the center of modern data collection methods, and perhaps the most common method of data acquisition tagged to site-specific management, is the use of a GPS receiver and a combination of computer hardware and software to collect site data. GPS uses a network of 24 satellites to provide geographic information, or coordinates, for points on the earth's surface. GPS was developed by the Department of Defense more than 20 years ago as a means of providing 24-hour positioning information regardless of weather. Global positioning systems have a wide range of applications and can be used as a vehicle navigation and/or guidance tool, surveying instrument, asset tracking tool and mapping instrument, to name a few examples.

Data Types

Two primary types of data may be collected to characterize site conditions: spatial and non-spatial data. While each data type may provide useful information in itself, an optimal management instance would utilize both spatial and nonspatial data. The integration of both data types allows the potential for a more detailed characterization of past, present and future conditions.

Spatial data is data that has a geographic position or a location. One may think of it as information that describes the location of geographic features as well as relationships among those features. Nonspatial data is descriptive data that is not tied to a geographic location. The power of data collection comes from collecting both kinds in concert with one

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another. The collection of both spatial and nonspatial data is applicable in virtually any management operation, albeit agronomic, equipment-related, irrigation, etc.

DATA ORGANIZATION

In stressing the importance of data collection as a means of initially implementing site-specific management strategies, it is important that data is collected with a purpose in mind and not just collected for the sake of collection. In essence, prior to collecting data, we might ask ourselves the typical questions of what are we collecting, why are we collecting it and how we will use the data once it is collected. The answers to these questions allow us to use the collected data more efficiently and effectively. Ultimately, the inclusion of collected data in management decision-making processes allows us added potential to characterize, quantify

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Information Is The Key . . .
(continued from page 18)

and qualify site conditions with the goal of better understanding the complexities of managing a golf course.

In this manner, geographic information systems provide site managers with a valuable tool for organizing and characterizing site data. It is the best tool for analyzing, preserving and managing collected data. A GIS is essentially a customized computer software system that offers two unique features: combined spatial and nonspatial data representation and data representation in thematic layers.

From an analytical standpoint, a key component of GIS

software is its ability to organize data in layers, with each layer storing one type of data (referred to as thematic data). Within the GIS, each thematic layer can be overlaid on top of another for analysis, map creation and other purposes.

Presently, several GIS packages are on the market that are available to golf course superintendents. Available GIS packages include MapInfo, ArcView and ArcInfo. Other data management packages customized for use in golf course operations include GCS, TRIMS, Qqest and others. While many of the packages customized for use in golf course management are largely focused on general nonspatial data management and organization, it is

likely that these packages will develop further to include GIS functionality, thus allowing true integrated management of both nonspatial and spatial data.

IMPLEMENTATION METHODS

Data collection and organization are two aspects of the site-specific management model that allow any site manager to implement its concepts immediately. As site-specific management is a progressive management strategy, applying it to multiple application areas must start with initial tasks that progress towards more detailed and specific applications (Figure 3). With available tools for data collection/organization and the promise of future

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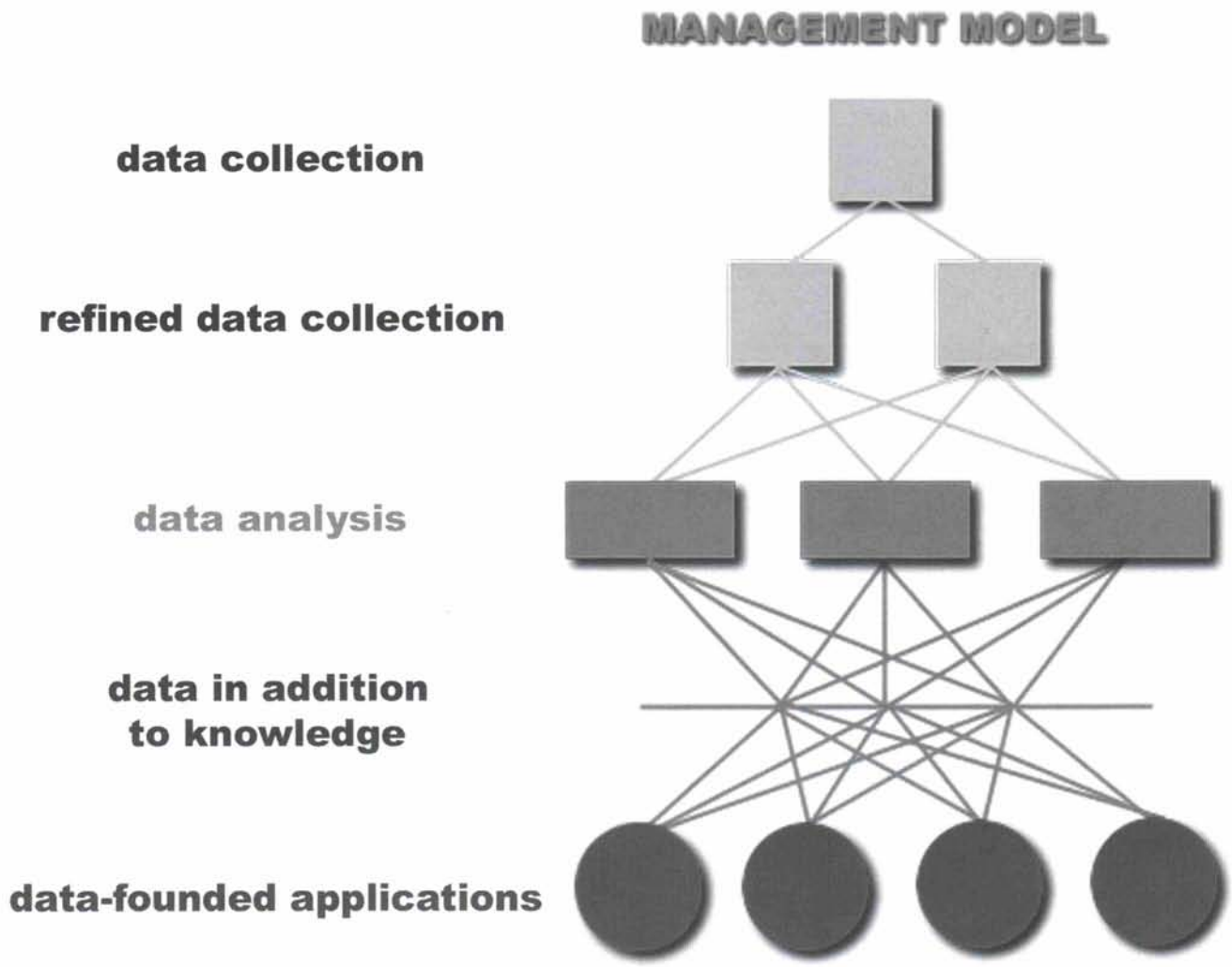


Figure 3. Progressive Concepts in the Site-Specific Management Model

developments in this area (technology and practice), site-specific management may be implemented in a variety of areas.

The following examples illustrate how site-specific management strategies might be applied to both agronomic pest management and equipment/resource management.

AGRONOMIC MANAGEMENT (PEST MANAGEMENT)
Data Collection

Scout and map locations (i.e., GPS) with pest problems.

Refined Data Collection

Identify and map additional site data that might affect pest problems.

Data Analysis

Use technology (i.e., GIS) to analyze map data with goal of determining causal agents contributing to pest problems; understand interrelationships among site conditions where pests exist.

Data In Addition To Knowledge

Utilize experience and site knowledge to determine cultural, chemical and/or other solution(s) to pest problems; identify solutions to accommodate spatial variances (site-specific solutions).

Data-Founded Applications

Perform application(s) to alleviate pest pressures accounting for spatial variances; manage problems with solutions specific to the instance.

EQUIPMENT/RESOURCE MANAGEMENT

Data Collection

Log equipment performance data (i.e., hours, location).

Refined Data Collection

Expand data-logging to include additional performance data (i.e., fluid temperatures, pressure, reel or implement position, material output, etc.); possibly transfer data from field to office via real-time communication link; tag data to equipment location instantaneously.

Data Analysis

Analyze equipment data to automate service, determine service intervals, monitor performance with goal of optimizing machine

performance; identify equipment performance by location on golf course.

Data In Addition To Knowledge

Introduce experience and knowledge to determine how equipment fleet might be better utilized; optimize machine, crew and application performance.

Data-Founded Applications

Optimize machine and crew performance through more efficient and effective resource allocation; automate equipment service; track equipment locations and performance.

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(continued from page 22)

NEXT STEPS

As site-specific management affords many potential benefits through its systematic approach to detailed site management, it starts with data collection and organization. The foundation that is set through data collection and organization will be a key determinant in the future of site-specific management, the extent to which it is applied and its ultimate effectiveness.

Detailed data collection and organization are two practices that a site manager may implement now through existing technologies and products. Implementation of these practices offers potential for added future advantages as a solid foundation of understanding site conditions and management intricacies is built. In implementing these basic concepts, one must remember that collection in itself offers no real benefits. It is only once collected data is integrated into a systematic process of data collection, data organization and analysis, data in addition to knowledge and data-founded applications, that its benefits will be realized and maximized.



¹Blackmore, Simon. *Precision Farming: An Introduction. Outlook on Agriculture.* 23:4. 275-280. 1994.

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