Motivating Clinical SAS® Programmers
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ABSTRACT
Almost every job advertisement requires programmers to be “highly motivated,” and for managers to “be able to motivate others.” But what drives clinical SAS® programmers? Clinical SAS programmers fill a unique void in the industry, and cannot be classified as either software developers or as statisticians. This paper will delve into the clinical SAS programmer in order to figure out his/her motivation, and stand as a guide for managers to inspire their programmers to new heights of achievement and satisfaction. This paper will discuss general motivational factors, and look at specific motivations of various classifications of clinical SAS programmers.

INTRODUCTION
There are many general factors that can affect programmers’ motivation. We will define three broad categories covering the working environment, recognition, and the team that you work with.

Further, Clinical SAS programmers are not typical software developers. While software developers generally have degrees in Computer Science, or at least an interest in computer science, this is typically not the case for clinical SAS programmers. Clinical SAS programmers come from a variety of backgrounds and generally do not set out to be SAS programmers, but rather fall into programming by happenstance. Because of this, clinical SAS programmers cannot be lumped into one homogeneous group. Instead, the individual strengths and weaknesses of these programmers need to be categorized. We attest that grouping these programmers into four broad categories: The Scientist, The Statistician, The Developer and The Lead Programmer and assigning projects based on their attributes will yield more motivated and happier programmers.

GENERAL MOTIVATION

DEFINITION
Before we get into what actually motivates Clinical SAS programmers, we need to take a quick look at motivation itself. The word motivation stems from motive which is defined as “something (as a need or desire) that causes a person to act”; in other words, something that a person cares about. To motivate is nothing more than “to provide with a motive.” And finally, motivation is defined as, “the act or process of motivating” (Merriam-Webster Online Dictionary). This etymology is important because it shows us that motivation is nothing more than an inner force that causes an individual to perform something. We constantly have motivation. For example, I am motivated to write this paper; you are motivated to read it; you are probably supposed to be doing something else right now, but are more motivated to read this. To be void of motivation is
impossible. People often say, “I’m not motivated to finish this task,” but what they are really saying is “I’m motivated to do anything else besides finish this task.” Although often overlooked, this is an important difference, and is crucial in meeting timelines, and producing high quality work. Understanding the latter enables you as a manager to harness that motivation, and the time spent not being motivated to finish the initial task, by giving him/her another task to do. This should sound counter-intuitive, “Why should I assign more tasks to the person who is not getting anything done?” If the employee only has one task, and is not inclined to finish it, he/she will waste many hours not finishing that task. These are exactly the hours, you, as a proactive manager, can capitalize on and you, as an employee, can stop wasting. To use these hours effectively, it is important that employees have both short and long term projects. These projects should also be a mixture of activities so that when bored, frustrated or unmotivated with one type of activity, the employee can casually work on a long term project and, usually get both done within the timelines.

**WORKING ENVIRONMENT**

Clinical SAS programming is a complex mental activity and managers need to create an environment that is highly conducive to thought. Each programmer manages hundreds of files, each of which may contain complex interdependencies needing to be managed in order to provide highly accurate output and documentation to hundreds of individual analyses in a timely manner. Any distractions which can cause a loss of concentration will have an adverse effect on the programmer’s ability to get their job done and this can lead to frustration and loss of motivation. Being in a situation that is not conducive to concentration drains programmers and makes them feel that they cannot tackle difficult problems. In order to prevent this happening it is essential that programmers have an environment that allows them to focus on their work without distractions. The following factors can help them do that:

- Hardware that allows the user to run programs and retrieve results quickly, thereby preventing them losing their train of thought.
- Reliable servers and networks. There is nothing more frustrating than having a server crash or VPN connection drop when you are in the middle of developing a complex piece of code.
- Allowing the flexibility to work remotely when this will allow greater concentration and productivity.
- A workplace which has good lighting, privacy, and quiet.
- A large monitor allowing for more effective review of data on a single screen.
- Avoiding unnecessary and/or repetitive tasks which could be replaced by new technologies or automation.

**RECOGNITION**

Clinical SAS programmers often have to put in a lot of extra hours to meet key deliverables. When programmers have put in a lot of work on a particular task, have produced work of particularly high quality, or have gone above and beyond what is
required of them in their job, it is important that this effort is acknowledged. This can take the form of comments in a meeting or by email from a manager that they recognize that the programmer has done a good job, monetary awards, or promotions for providing a consistently high quality of work. Knowing what you have done is appreciated will make you more likely to produce high quality work in future. The following factors can help meet recognition needs:

- Knowing that there are opportunities for career development and growth.
- Knowing that there are opportunities to improve and work on interesting projects.
- Being provided with opportunities to learn and use new skills.
- Establishing an environment where people are treated fairly—this is subjective, but it is easy to lose motivation if you see someone else rewarded when you feel like you have done an equal or better job.
- Providing/Receiving clear, regular and consistent feedback.

**TEAMWORK**

The people who you work with have the largest impact on your morale and motivation. A friendly, collaborative environment that encourages hard work is what we need to strive for. Inspiration comes from working with a team that cares about doing a good job and getting work completed on time. Conversely, having even a single person who is not motivated can affect some or all of the other members of the team. The following factors can help foster teamwork:

- Having clear and specific deliverables and timelines for each member of the team. Not knowing what you are supposed to be doing can result in a lot of wasted time.
- Being given the responsibility to make decisions that you are qualified to make and not being micromanaged.
- Feeling that you have support from the team and management when you need assistance or clarification.
- Feeling that you are a valued member of the team and that your opinion is being taken into account.
- Clearly communicating when important information needs to be shared within the team.
- Sharing responsibility – when something goes wrong, the root cause should be looked at and methods of avoiding the situation in future should be discussed rather than trying to assign blame or covering up problems.

**THE CLASSIFICATIONS**

After setting up a motivational work environment as detailed above, the final action of a good manager is to assign projects accordingly. Assigning projects might be the most critical aspect of allowing programmers to exercise their full motivation. Give a highly motivated programmer a job that he/she does not see as important or is not good at, and you will undoubtedly see his/her motivation decrease sharply. To assign projects correctly it is important to assess the strengths and weaknesses of your staff and fit the
project, or piece of the project, to his/her specific attribute. To do this, we propose that clinical programmers be classified into four broad groups: The Scientist, The Statistician, The Developer, and The Lead Programmer.

Note: All clinical programmers have traits that are similar. They can manage complex data manipulations, can keep track of data from different sources, can understand inherent programming challenges, and fit into one of these categories:

**The Scientist:**
- Highly detailed
- Purposeful and Methodical
- Scientific background
- Understands Laboratory data

**The Statistician:**
- Statistical background
- Understands analytical methods
- Highly detailed
- Understands statistical models
- Understands importance of each data point and its effect on the analyses
- Ability to visualize and interpret complex statistical concepts

**The Developer:**
- Understands “Big Picture” needs
- Ability to learn and apply new technical skills and concepts quickly
- Logical thinker
- Aptitude for problem solving

**The Lead Programmer:**
- Highly organized
- Can assign and triage tasks in real time
- Understands the intricacies of the clinical trial
- Understands the relationships between all clinical trials for the product
- Knows the data
- Good at team work
- Good communicator

**SCENARIO**

In order to describe how matching a specific task to an employee’s strengths would help produce more motivated employees and higher quality work, we will use the example of
an end to end CDISC\(^1\) implementation. CDISC standards implementations are sweeping through pharmaceutical companies and presenting the clinical SAS programmers with a lot of interesting work if assigned correctly.

For the purpose of this example let’s assume that the team of programmers we have to work with fits exactly to our categories, and that we have one of each.

<table>
<thead>
<tr>
<th></th>
<th>Developer</th>
<th>Scientist</th>
<th>Lead</th>
<th>Statistician</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of Experience</td>
<td>5</td>
<td>15</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Years at Company</td>
<td>.5</td>
<td>6</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

After a meeting with management, the following subprojects were allotted, allowing one programmer to lead each one. The question remains, “Who should do what?”

Project Organization
- Organize meetings
- Take minutes
- Follow up on Action Items
- Provide status updates to upper management
- Prepare individual teams for actual implementation

Process Documentation
- Create flowcharts of business processes
- Create documentation of macros
- Prepare training materials

Define.xml Creation
- From documentation define what metadata is needed for the define.xml
- Create a schema for how the metadata connects together
- Learn XML and XSLT
- Write macros to create the define.xml from the metadata
- Document the macro
- Provide training

ADaM\(^2\) Structure
- Fit data into pre-specified analysis datasets based on the implementation guide
- Define and document the difference to the current model and its effect on downstream analyses

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\(^1\) Clinical Data Interchange Standards Consortium - The mission of CDISC is to develop and support global, platform-independent data standards that enable information system interoperability to improve medical research and related areas of healthcare. More information can be found at: [www.cdisc.org](http://www.cdisc.org)

\(^2\) Analysis Data Model – CDISC’s recommendation for standardized structure of analysis data sets. More information can be found at: [http://www.cdisc.org/models/adam/V2.1_Draft/index.html](http://www.cdisc.org/models/adam/V2.1_Draft/index.html)
- Ensure that no data is lost in the transformations
- Create and provide training

Obviously, the CDISC implementation is a long project. It is important to realize that the assignments you make are going to affect these people for a considerable amount of time. With this realization, you should understand how large the positive effect is of assigning a good job to the right programmer, and more importantly, the detrimental effect of assigning the wrong job to a good programmer.

**PROJECT ORGANIZATION**

At first glance, it would be natural to want to assign the Project Organization to either of the veterans (Statistician, Scientist). Both have been with the company the longest and both have extensive experience. But will either of these programmers be happy doing the work as described by the Project Organization? Both the Statistician and Scientist are more “hands on the data” kinds of people. The constant organization that this project requires will eventually tire out both of these veterans. The best fit here is the Lead Programmer. From the experience leading meetings, organizing people, meeting timelines, and understanding the whole clinical trial process, the Lead Programmer would be the most likely to stay motivated in the long run.

**Take-home message:** Lead programmers are good organizers.

**PROCESS DOCUMENTATION**

The dreaded documentation - the bane of most programmers’ existence. Documentation has to get done, and has to be done well. Although it might be surprising to hear, some people like writing documentation. The people that usually like documentation are those that are interested in the details of the content that it will provide. Assigning Process Documentation to your Developer is counterproductive. The developer will get it done, but will hate every minute working on it and it will probably take him twice as long to do an adequate job. Generally the developer, with his quick understanding of complex topics, sees no need for thorough documentation. The best documenter in the company is the Scientist. The Scientist is highly interested in the details of the processes, and is inclined to write them down, if at the very least just so he/she does not have to figure them all out again.

**Take-home message:** Scientists appreciate documentation.

**DEFINE.XML CREATION**

The creation of the define.xml is a complicated process. The responsible party will have to figure out all the connections of the various metadata that link together and will then have to gain a basic understanding of XML and XSLT. This is a clear cut job for the Developer. The Developer will enjoy learning the basics of XML and XSLT, and will truly like putting it all together in SAS. On this same note, when it comes time to document the define.xml process, the Developer should work together with the Scientist.
to ensure that quality documentation is created. As noted above, if left alone with the documentation your developer will surely get bored.

Take-home message: Developers like to learn new things, but not necessarily document them.

**ADaM STRUCTURE**

In order to start on this project, the individual must have a good understanding of the current structure of the analysis datasets and how they feed into downstream table, listing and figure (TLF) programs. The key to this project is making sure that no data is lost in the transition, and that the standard TLF programs are ready to be run when the analysis datasets’ structure is final. There are two good prospects for this work; the Lead Programmer, and the Statistician. The Statistician is inherently interested in how the changes to the dataset influence fitting them into statistical models and the effect this will have on already programmed tables, listings and figures. The Lead would also be good for this. The Lead understands the whole clinical trial process and knows the interdependencies between analysis data sets and TLF probably better than anyone. On that note, we should realize that this is not a good job for anyone else. The Scientist is probably not particularly interested in any of the interdependencies, and the Developer wouldn’t have enough programming to do. Both of these people’s times could be used more effectively with another task.

Take-home message: Statisticians like analysis.

**CONCLUSION**

Once an employee’s motivation is lost or misguided it is hard to regain. Employees and managers need to work together to develop a working environment that provides constant inspiration. Couple that inspiration with logically assigning projects based on the employee’s attributes and aptitude and you will notice a sharp increase in quality and motivation from everyone.

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**REFERENCES**

Merriam Webster’s Online Dictionary:
http://www.merriam-webster.com/dictionary/motivation
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Only through discussion do we get any more answers. Please contact us with any questions or comments.

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