Using Red, Green, Blue Color for Modeling Changes to Organizational Structures

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ABSTRACT

Many theories have been developed that attempt to explain innovation-driven organizational transformation, each with their respective models. Most process models use geometric shapes to represent variables of interest, and lines and arrows to show effects and relationships. While these models are useful for illustrating direct causality, they are less useful for illustrating more complex interactions and transformations. We propose that a model of the organization that is metaphorically-based on the Red, Green, Blue color model used for computer display color generation can provide a useful way of identifying the state of organizational structures and for communicating subsequent changes to that state caused by external factors. A pilot study has been developed that applies portions of the model and demonstrates its potential for modeling technology-driven job transformation.

LITERATURE REVIEW

Rogers (1995) defines an organization as "a stable system of individuals who work together to achieve common goals…". (Arrow, McGrath, & Berdahl, 2000) define a "group" as "…a set of patterned relations among members, tasks and tools". This definition is interesting because it includes tools as part of the definition of what a group is. From this perspective, an adopted technology does not so much affect the organization, but is rather part of the organization. Other models of organizations have been developed that focus on social aspects such as power & influence, information flow, task/process. (Rogers, 1995) defines an organization according to five structural attributes: centralization, complexity, formalization, interconnectedness, organizational slack & size. (DeSanctis & Poole, 1994) are less specific about identifying the attributes of an organization, and focus instead on task contents and constraints, which they refer to as the organizational "structure". More recently, theorists are turning to the object-oriented paradigm as a means of modeling organizations (Handley & Levis, 2001; Ishida & Ohta, 2001). In this context, the organization "object" is modeled as having both attributes and behavior. Using constructs from the Unified Modeling Language (UML) such as interaction diagrams and class diagrams, researchers are able to codify the organization's descriptive "attributes", document specific processes within the organization (behavior), and map the organization's inputs and outputs (messages).

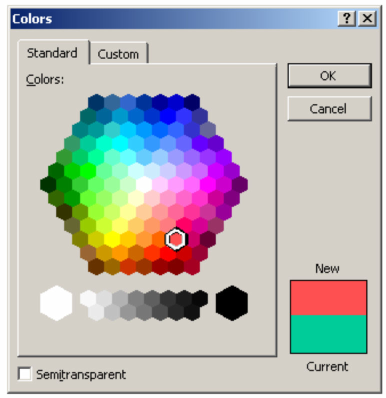
(Arrow et al., 2000) identify a large body of research that uses the functionality of computers as a metaphor to describe how groups process information. This is a natural comparison to make since the computer is in fact a construct designed to replicate human cognitive processes. (Wegner, 1987) and (Wegner, Erber, & Raymond, 1991) identify encoding, storing & retrieving information relating to computer memory functions. The five basic data processing activities: collection, storage, generation, processing & transportation can easily be applied to individuals as well as to groups. It is these basis information processes that dominate individual tasks within the group.

RESEARCH MODEL

To help conceptualize organizational transformation, we have developed a model of the organization that uses colors as a metaphor for organizational attributes. We borrow some concepts from computer display color theory, notably, the red/green/blue (RGB) color model. In its simplest form, this model is conceptualized as a cube (Armstrong, Charumilind, Cho, & Lowenthal, 1998). (Bunks, 2000) describes the cube as having three axis representing the color values of red, blue and green in the range of 0 to 255. Three of the corners have pure red, green and blue values. Three other corners consist of perfect mixes of two of the three RGB colors: magenta(R255,G255), cyan(R255,B255) & yellow (G255,B255). The remaining two corners are mixes of all three: black (0,0,0) and white (R255,G255,B255). Any one of the 16,581,375 possible colors can be represented as a discrete location within the three-dimensional space bounded by the cube's exterior.

Four elements of the RGB model are of particular interest. The first is that the colors are additive and subtractive. This allows the summing of multiple instances of attributes to arrive at a new color representing the sum of all attributes. The second is the representation of any mixture of colors as a specific location within the model. It should be noted that proximity equates to attribute similarity in any dimension. The third is a result of the prior two; as you add more of any one of the primary colors, the location within the cube that identifies the mixture moves toward the primary's corner in a predictable distance and direction. The fourth is that we have developed names for specific classes of color, and can discern differences in shade while maintaining the ability to ascribe membership to a particular class such as "a shade of green". The idea that you can add more "green" to the color and it will become "greener" is an important attribute of our research model.

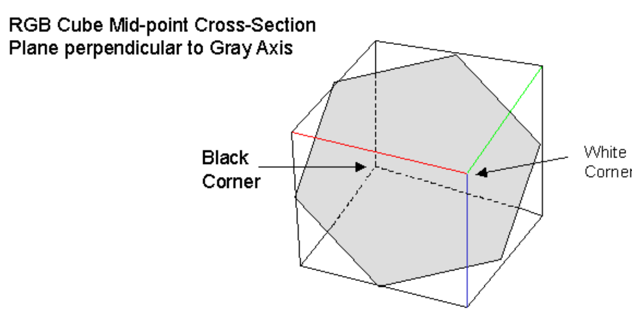
Illustration 1: Hexigonal RGB Representation



While the cube is conceptually accurate, in practice it is difficult to use due to the difficulty in accurately portraying all color values within the cube simultaneously on a two dimensional computer display. Often, software packages that use the RGB pallet for color selection simplify the cube into a two-dimensional spectrum, or borrowing from the similar HSV (Hue, Saturation, Value) color model, as a flattened cone with hexagonal color regions (Microsoft, 2000). An example taken from Microsoft's PowerPoint software is shown in Illustration 1.

For use in modeling organization structures and transformation, we have used a hexagonal cross-section of the RGB color cube to represent the domain of job types within an organization. The hexagonal cross-section will two-dimensionally represent the RGB cube as if viewed looking straight on at the white corner (Figure 2). Three RGB color lines trisect the hexagon representing a continuum of increasing intensity for each primary color where the other two attributes are simultaneously held constant at a minimum value. This places the region where all attributes are even and at their maximum in the center.

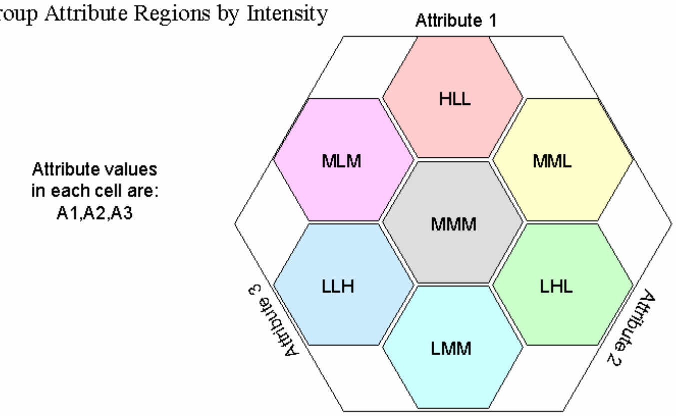
Figure 2:



The two-dimensional representation has a conceptual limitation in that it cannot accurately depict values less than half of the total possible intensity (<127) due to the fact that those values are on the "other side" of the cube and can not visually be distinguished from values located directly above. This also happens for any balanced set of values, since they are all located on a line perpendicular to the viewing plane connecting the white corner of the cube depicted as the center point of the model, to the opposite black corner directly beneath. Since we are not suggesting the two-dimensional model can be used to analyze discrete values, this is not thought to present a serious constraint.

In order to superimpose the model of the organization on the hexagon, the colors are assigned to organizational attributes. In our research we use the basic information-processing attributes relating input, processing & output, naming them memorizing, decision-making & communicating. Other variables of interest might just as easily be used. We then attempt to identify intensity approximations for each attribute. Given the subjective nature of our analytical instruments, low, medium and high are felt to provide an acceptable level of accuracy. At its simplest level, this creates seven identifiable regions (Figure 3).

Figure 3:
Group Attribute Regions by Intensity



The rules that were used in the assignment of attribute intensities to specific regions is as follows:

- An attribute is “high” only in the cells at the corners of the attribute “triangle”
- An attribute is “low” if it is in a cell not in contact with a cell where the attribute is “high”.
- There can only be one “high” attribute in any single cell

The value in using the color metaphor is that it allows us to broadly summarize the nature of an organization as a mixture of information processes with an identifiable “tint”. While there would be little value in attempting to specify the exact mixture of tasks, there would be value in being able to say the organization was “greenish”. We could then hypothesize that a “greenish” organization would become more “reddish” if they adopted an innovation that had a strong “reddish” tint. In other words, we may not be able to predict the exact color of the post-implementation organization, but can with some accuracy state the direction of the change and the region it might reasonably occupy.

Likewise, we can also factor in the influence of concurrently-used technologies by ascertaining their “colors” and summing the values.

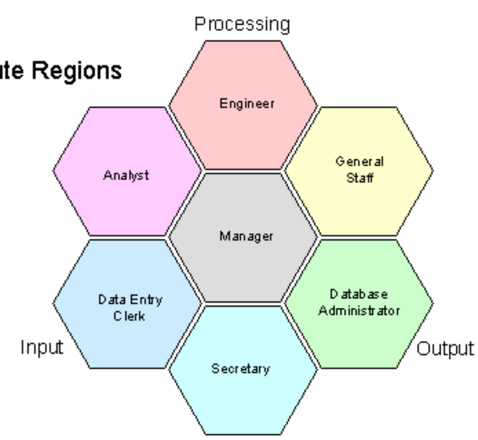
The regions in between red/green/blue are recognized not only as a hybrid of the two colors, but are distinctly identifiable. Colors such as orange, yellow, aqua, purple, pink are mixtures, yet are identifiably different from the primary colors, even though an infinite number of variations exist.

MODEL APPLICATION

This model will be used in research relating to how the adoption of a technology influences organizational transformation. In this study, we are looking both the transformation of individual jobs within an organization, and the transformation of the organization as a whole. We describe a particular “job” held by an individual as a portfolio of tasks. Each task is viewed in terms the individual’s information-processing activity: input, processing & output (Arrow et al., 2000; Wegner, 1987; Wegner et al., 1991). Rather than showing abstract combinations of each attribute, we have “colored” each region by assigning a widely-recognized job title that we believe captures the essence of the different potential mixes of each attribute (Figure 4).

Figure 4:

“Colored” Attribute Regions



We have applied the model to a case study of insurance claims processors (Wenger, 1998). In this study, the claims processor “job” portfolio includes entering data into a database from paper insurance claim forms with accompanying receipts. The database has very limited computational capability so the claims processors are required to make many decision about whether claims are reimbursable according to the various benefit plans and rules. While the software application is very simple to use, it takes many months for an employee to learn all of the explicit and tacit benefit rules so that a claim can be quickly entered. Because of this high cognitive load, we place the claims processor “job” somewhere in the region of “analyst” because there is significant input as well as remembering. If the software application the claims processors use was replaced with another system, there are two obvious possibilities for job transformation. In the first scenario, the new system automates much of the business rules so that the system is making more of the decisions. This results in a lower cognitive load changing the job portfolio to one containing a much higher input component. This would result in a shift from within the "analyst" region towards the "data entry" region. In the other scenario, the data entry component is reduced as a result of either the adoption of image scanning technology, or perhaps a system that accepts claims "online". In this case, the data entry component would be reduced resulting in a change to a job portfolio with a higher cognitive / processing component. This could then be modeled as a shift within "analyst" region towards the "engineer" region.

The implications for this type of change are obvious in terms of training, education, compensation, group culture, management style, etc.

FUTURE DEVELOPMENT

We believe that the model holds some promise for being able to represent the state of a variety of organizational structures in a holistic way. One area we see the model being used is to represent the impact of merged organizations. Since the RGB factors can be added and subtracted, the attributes of multiple organizations can easily be summed. Another possible use would be to represent sub-groups individually, then combining the results to analyze the larger organization as a whole. The model be even more useful if regions on the matrix could be identified in some semantic way to characteristics recognized in industry such as "hierarchical", "network", data entry, "knowledge work" etc. This would extend the color metaphor even further since a mix of two primary colors yields a third color that has a unique name. This model is being tested in an extensive research relating to the adoption of ERP systems at four universities. The transitional impact on both individuals and groups is being studied, and the model is being used to represent both job and group attributes at two different levels.

CONCLUSION

As our theories relating to adoption of innovation and organizational transformation become more mature, a need to more accurately represent the nature of the transformation arises. We are hopeful that the state of organizational structures can be effectively modeled using the RGB color "chooser" as a metaphor for visualizing the structures. A pilot study has been developed to test and develop the model. The results of the study will be used to identify and confirm some of key the structural attributes that can be applied to the model. The refined model will then be applied to a larger research effort.

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