A Conversation about "Living Control Systems"

People are usefully viewed as "living control systems." That we are indeed "living control systems" is rife with implications for understanding, controlling and improving the performance of people in the workplace, including ourselves. This paper presents an imaginary conversation about "living control systems" that takes place between me and a fellow I'll call "Bill." The conversation starts immediately below.

FRED: I think a little-known but very important way of looking at the behavior and performance of people is to view them as "living control systems."

BILL: What do you mean by "living control systems"?

FRED: I mean we function or behave like any closed-loop control system. In plain language, we act to keep "what is" aligned with "what should be." That's what all control systems do.

BILL: What do you mean by "closed-loop"?

FRED: If you don't mind, I'd like to come back to that later. It'll make more sense after we cover some other ground.

BILL: Okay, so what is it we control?

FRED: We control various aspects of the world around us and various aspects of ourselves. We control what time we get to work, and we control the speed of our car on the way there. We control what we wear and how we look. We control lots of things.

BILL: What do you mean by "control"?

FRED: By "control" I mean we act to achieve and maintain some desired state of affairs; more specifically, we act to bring some targeted variable to a desired value and keep it there; for example, our arrival time at work.

BILL: Okay. What do you mean by "targeted variable"?

FRED: As some wag once said, a variable is something that varies. To be precise, a variable is something that has a value that can vary. Height is a variable. Our arrival time at work can vary; it's a variable. Height can vary. So can weight. So is the amount of money in your wallet. So is the size of your paycheck. Ditto for the error rate in a production process and the amount of wasted material in a factory. A "targeted variable" is a variable we select for the express purpose of bringing its value to some desired level and then keeping it at that value.

BILL: Okay. I get what you're talking about with respect to "variable" and what you mean by "targeted variable." So how do we control those "targeted variables"?

FRED: The simple answer is by way of our actions; more specifically, we act in ways that directly or indirectly affect the value of the target variable.

BILL: Wait a minute. What do you mean by "directly or indirectly"?

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FRED: Well, sometimes the effects of our action on the variable we wish to control are direct and immediate. For example, I want more coffee in my cup. I go over to the coffee pot, pick it up, and pour coffee into my cup until the level of coffee in the cup matches what I want it to be. That's pretty direct. But suppose there isn't any coffee in the pot. Now I have to make a fresh pot. There are several steps involved in making a fresh pot of coffee and those stand between me and a full cup of fresh coffee. That's a bit more indirect. Suppose I want the error rate in a production process to be much lower. No way can I directly affect that. I might have to modify the process or even reengineer it. I might have to substitute different materials or perhaps take a look at the people who carry it out. Or, let's suppose I'm a new CEO who has been brought in to turn around a company in trouble. That, too, is something I can't achieve through just my direct, immediate actions.

BILL: Okay, I see. It's kind of a matter of complexity.

FRED: Right.

BILL: Regardless of complexity, how do we know how we're doing?

FRED: In all cases, it's by way of our perceptions, what we can see, hear, feel, etc. In some cases, we can see how we're doing. I don't need anyone to tell me how I'm doing when it comes to filling my coffee cup, but I might need some help determining what's happening with the error rate in that production process. Is it going up? Down? Staying the same? Even if I'm looking at a report prepared by someone else, it is my perception of what the value of the error rate is doing that I can compare with what I want it to be and therein lies a key element in control: the ability to compare what is the case with what you want to be the case. If they line up, fine; if they don't, we probably need to do something about it. A discrepancy between the current or perceived value of the target variable and its intended value constitutes an error and is generally the occasion for action.

BILL: Okay. Let me see if I've got this straight. I want some variable to have a certain value. I check to see what its current value is and if there's a difference I do something to close the gap. I keep tabs on things to see how I'm doing. Once I get it to its desired value, then what?

FRED: You have to maintain it in the face of disturbances; you have to keep it at its intended value.

BILL: What's a disturbance and why do I have to maintain it? If I achieve the intended value am I not done? Haven't I exercised control?

FRED: Yes, you've exercised control – to a certain extent – but no, you're not done. There are other actors and factors in your world that affect the very same things you wish to affect. When these affect the value of the target variable they are said to "disturb" it and your actions have to counter or offset the effects of these other actors and factors. For the most part, we do this more or less automatically but, on occasion, we have to give those "disturbances" some thought, too.

BILL: Okay, so what you're saying is that there's stuff in the surrounding conditions that can interfere with my efforts to control the value of a target variable.

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FRED: Right. Yes, and the surrounding conditions which house the target variable and those potential disturbances are very much parts of the thinking that has to go on.

BILL: Do you have a way of showing all this in a diagram?

FRED: Sure do. Take a look at this.

Fred shows Bill the diagram below.

"A LIVING CONTROL SYSTEM"

Person   Situation

Intended   Surrounding
Value   Conditions

Actions   Target
                                 Variable
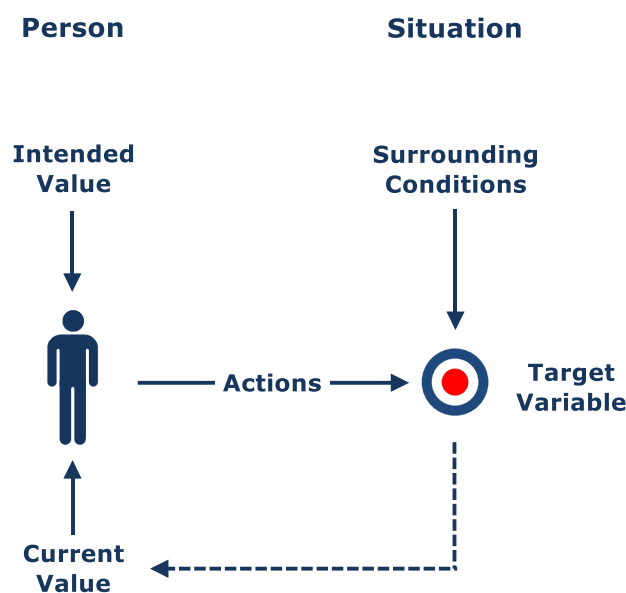
Current
Value

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Bill: Where are the disturbances?

Fred: The disturbances we just talked about are part of the surrounding conditions. The current value is the perceived current value.

Bill: Where's the error that gives rise to action?

Fred: It's in the person, where the intended value and the perceived current value of the target variable are compared.

Bill: What's the dashed line?

Fred: That's the feedback loop, the means by which you perceive or are informed about the current value of the target variable. By the way, if you don't remember anything else, remember this: "Feedback is information about the actual state of affairs that can be compared with the

intended state of affairs." Coincidentally, that answers your earlier question about "closed-loop." It's feedback that closes the loop and makes control possible and effective.

Bill: How's that?

Fred: Imagine there was no feedback loop; there was no information about the actual value of the target variable that could be compared with its intended value. What would happen?

Bill: Well, for one thing, I wouldn't know if there was an error or not so I wouldn't know whether to take action or not.

Fred: Right. What else?

Bill: Well, with no information about actual conditions, I couldn't tell if my actions were having the desired effects.

Fred: Right again.

Bill: I see a problem with your diagram.

Fred: What's that?

Bill: Well, earlier, we were talking about direct versus indirect and I can see how the diagram fits with the filling your coffee cup example, but I don't see how it fits with the error rate or corporate turnaround examples. Those are ones you said were indirect.

Fred: Right again. Good job. Now we introduce another element of control, what I call the "Solution Path" or "Achievement Path."

Bill: Can we take a break? I have a hunch this is going to take a while.

Fred: Sure. How about 15 minutes?

Bill: Fine.

Bill and Fred take a break and, 15 minutes later, they're back at it.

Bill: So where do we pick up?

Fred: We're going to tackle the notion of a "living control system" but in a situation where the target variable cannot be directly affected and must instead be indirectly affected. To do that we will need to look at what I usually call the "Achievement Path." They are one and the same. Then, after we've looked at the issue of Achievement Path, we'll look at how that fits with the basic control system model we just looked at.

Bill: Okay by me. Let's get started.

Fred: We're going to focus now on how a "living control system" operates in an environment where the desired value for a target variable cannot be achieved via direct, immediate action. Instead, the effects of direct action must ripple through the structure of the situation, eventually making themselves felt as changes in the value of the target variable.

Bill: What do you mean by "ripple through"?

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Fred: I'm referring to the fact that the target variable, and the person trying to change its value, are both embedded in or part of some larger structure, a network of variables if you will. What we're looking for is a path from the person to the target variable. Typically, there are three different kinds of variables that lie between the person and the target variable. First, and most important, are "Driver Variables." These are variables that do in fact directly affect the target variable. Next are "Accessible Variables." These are variables the person can affect through direct, immediate action. Last are "Connecting Variables." These are variables that connect or link the Accessible Variables with the Driver Variables and thence to the Target Variable.

Bill: Do you have another diagram?

Fred: You bet. Take a look at this.

The "Rippling through" Path
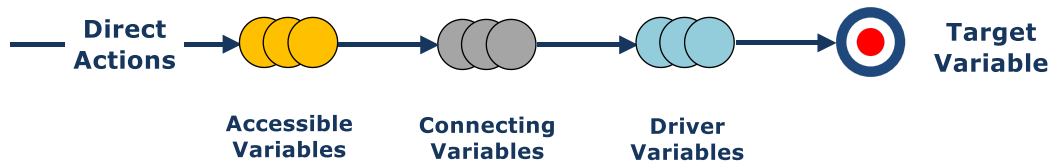
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Bill: That diagram suggests more than one of each kind of variable might be involved.

Fred: That's true, especially when you start looking at the structure of a company's financial accounts. Lots of variables affect cost. Ditto for net or profit.

**Bill:** Do you have a real-world example?

Fred: Sure do. When I was first appointed as a division director at one of my employers, the division had recently moved into new, more expensive space. The division's clients were complaining about the increase in something called "load rate" and badgering me to do something about it. I had no idea what "load rate" was so I looked into it. Turns out it's an element in the calculation of charges to the division's clients. I found this out by constructing a diagram of the division's financials. (Fred shows Bill the first diagram below.) As you can see, load rate is calculated by dividing the indirect costs of work by the direct costs. The direct costs are then multiplied by load rate to yield load. Load is added to the direct costs to determine charges to programs, my division's clients. What had changed as a result of the move, were the allocations from corporate, so I took a look at those, too. (Fred shows Bill the second diagram below.) What was driving load rate up was a big increase in charges for the space my division occupied. That was driven partly by an increase in the charge per square foot and partly by the fact that my division now occupied an additional 5,000 square feet.

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The Structure of Charges to Programs
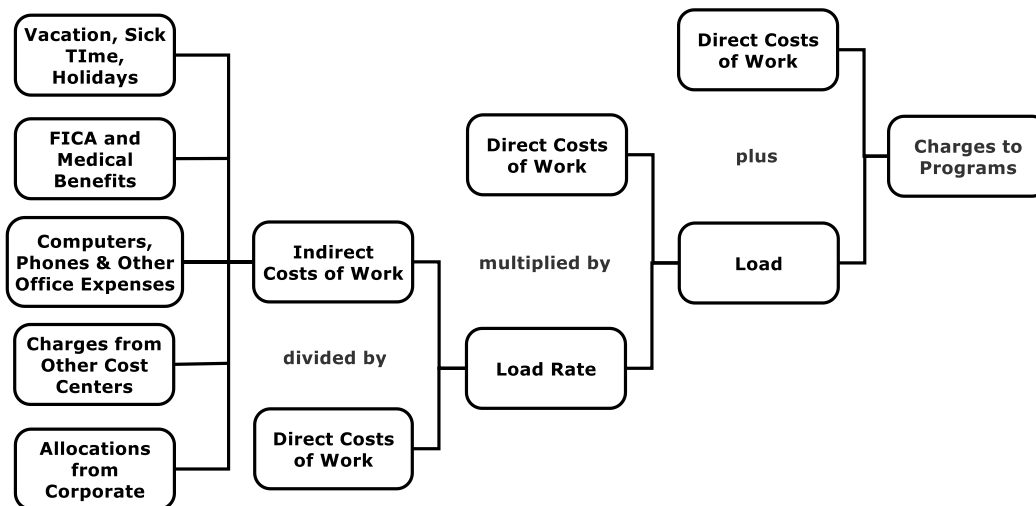
## The Structure of Allocations from Corporate
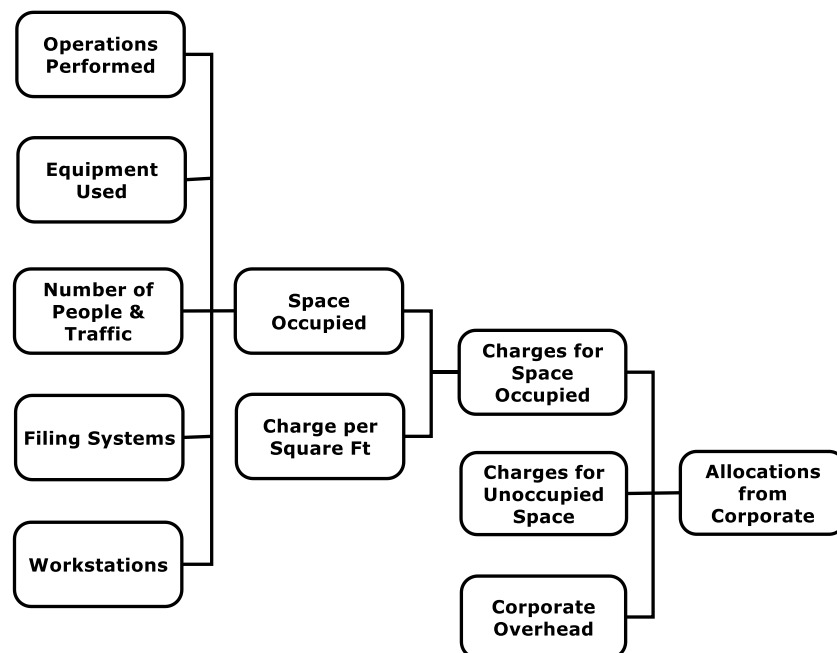
Bill: So what did you do?

Fred: Well, I had 20,000 square feet of space in one building and 5,000 square feet in a neighboring building. The obvious thing to do was to see if I could fit the 5,000 square feet in the

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neighboring building into my main space. My main space had 3,000 square feet of extra space so I needed to find a way of reducing the space requirements of the operation in the neighboring building. Turns out that operation used tub files, which had a big horizontal footprint. I shifted the operation to vertical files and the operation's footprint was reduced by enough that I could relocate it in the main space and turn the 5,000 square feet back to corporate. That greatly reduced the space charges to my division and reduced load rate by quite a bit, too. My clients were satisfied.

Bill: Nice work. So how does all that fit with what you've been telling me?

Fred: Good question. Let's look at another diagram. (Fred shows Bill the diagram below.) This one shows the Achievement Path for reducing load rate and thus charges to programs. My direct actions consisted of changing the type of filing system used. That in turn changed space utilization, space required, the operation's location, the space occupied, space charges, allocations from corporate and indirect costs. As you can see, there was one Accessible Variable, several Connecting Variables and one Driver Variable.

Accessible Variable(s)	Connecting Variable(S)	Driver Variable(s)	Target Variable

Direct Action →

------------------Achievement Path-------------→

Type of Filing System	Space Utilization Space Required Operation Location Space Occupied Space Charges Allocations Indirect Costs	Load Rate	Charges to Programs
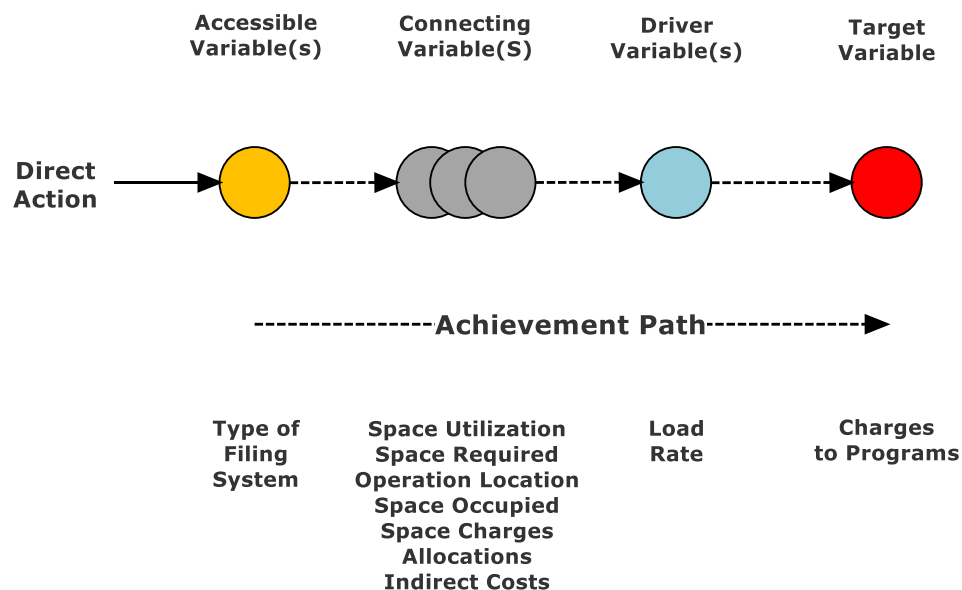
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Bill: Hmm! That's impressive. Were there any of those "disturbances" you mentioned?

Fred: The only one I can think of ties to the type of filing system. The vertical filing system I wanted to use cost just under $20,000. My boss required me to work up a cost justification in order to purchase it. I did as he asked. My basic case was that the vertical filing system would also significantly reduce space requirements in several other operations – under my boss' purview and elsewhere in the company, reducing space requirements and charges there as well. He authorized the purchase and that "disturbance" was out of the way.

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Bill: So, let me see if I understand all this. If I want to change the value of some Target Variable, I need to take a look at the larger structure of variables in which the Target Variable is embedded. My aim is to identify a path that runs from variables I can directly affect through the network and eventually make themselves felt in the form of changes to value of the Target Variable. That path runs from Accessible Variables through Connecting Variables to Driver Variables and the Driver Variables directly affect the value of the Target Variable. All along the way there are surrounding conditions that might have other factors that also affect the variables in question. All along the way there are feedback loops that keep me informed as to changes in the value of the variables in question. If I get this all right, the changes I make "over here" to Accessible Variables" will "ripple through" the structure of the situation and make themselves felt on Connecting and Driver Variables and, eventually on the Target Variable. Do I have that right?

Fred: Very good, Bill. You have it exactly right, which leads us to my last diagram, one that ties it all together.

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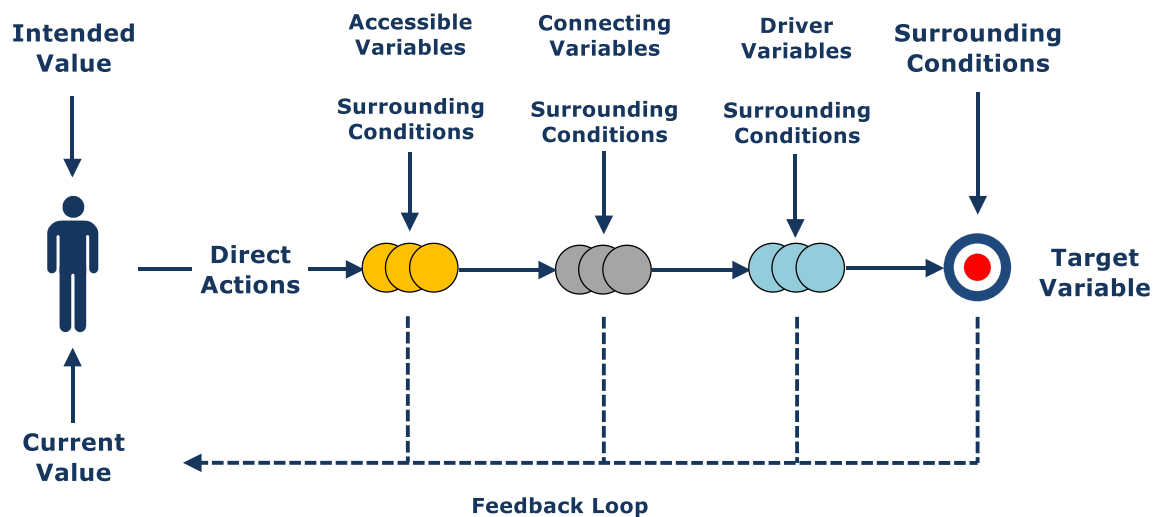
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Bill: Wow. That's a lot to digest. Let me look it over for a minute or two.

Fred: Sure. Take your time.

Bill studies the diagram for a few minutes.

Bill: Okay. I see how it all fits together. The basic control system diagram we looked at earlier is fine if the Target Variable is something you can affect through direct, immediate action, but if you are dealing with a more complicated situation, the diagram you just showed me illustrates the various issues you have to grapple with in order to control the value of the Target Variable.

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Fred: You got it, Bill. Congratulations!

Bill: I'm going to need more than congratulations to put all this to work.

Fred: I'm happy to lend a hand, Bill.

About the Author

Fred Nickols is an ex-Navy Chief Petty Officer, a writer, a consultant, a former executive, and the managing partner of Distance Consulting. He is an organizational generalist, a tool maker, and a solution engineer. His web site contains more than 200 free articles, book chapters and papers as well as the award-winning Knowledge Workers Tool Room. There is also an entire section devoted to Control Theory. Fred can be reached via email by clicking here.