# Flavors of the Month: Comparing and Structural and Mathematical Approaches

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ABSTRACT

The most important part of model formulation is identifying exactly what is the problem being solved. This often overlooked first step can have serious consequences on the choice of modeling framework and the resulting policy recommendations. To illustrate this point, this work addresses the emergence of managerial fads, wherein  business methods designed to increase some measure of success in firm emerge, and but are then rapidly replaced. First, using a structural framework built from fundamental organizational and social theory, the emergence of cyclical adoption and abandonment of managerial practices is addressed. Using this framework, the shape of the reward structure is identified as  a key policy lever. Next, the seemingly same problem is addressed but using a behaviorally modified Kuramoto synchronization mathematical framework. However the policy that emerges here leverages information availability, and instead of  directly damping oscillations asks what amount of variety in management styles is appropriate for a firm.  While this work has a secondary contribution of introducing mathematical concepts of synchronization to the System Dynamics community, it primarily illustrates that neither approach is necessarily 'better' or 'worse' than the other. Rather, this illustrates how the applicability of either approach is a function of the initial problem definition.

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# 1. Introduction and Background

Since at least the 1980's, there have been a seemingly endless parade of 'management fads'. As defined here, these are business methods and/or philosophies designed to increase quality, output, or some other measure of success in firm that emerge, and but are then rapidly replaced.

These methods appear, spread throughout the firm, but are eventually replaced by another fad, even those that could have been beneficial if left to develop. As an example, in (Oliva et al., 1998), the authors describe a semiconductor firm trying over a dozen different improvement initiatives over just a few short years. This cyclic emergence and replacement of ideas, e.g., the 'flavor of the month' problem, could be viewed as inefficient by resulting in wasted time and resources in gaining acceptance of a new philosophy and developing its eventual replacement.

Hoes does this persistent phenomena emerge in a firm, and what policies can help introduce a new beneficial management idea that sticks?

There are multiple options to approach this problem, including the sociotechnical structural equation approach that often underpins classical System Dynamics approaches. In this approach, qualitative insights on how individuals or groups which a firm may be translated into structural theory and abstracted into mathematical concepts. Using the resulting object, new insights may be gleaned, or policies imputed.

However, instead of creating new structural theory from qualitative mapping, we could instead rather relying on applying existing mathematical frameworks that have been shown to apply in natural settings (such as the application of PID controller design to commodity price formation as in Paine, 2022). Indeed, the above description of the emergence of managerial fads closely matches the concepts of synchronization explored in many physical, biological, social, and chemical systems (S. H. Strogatz, 2000). Synchronization studies how organized and time-coupled behavior emerges from seemingly dissociated individual interactions and has been applied to mechanical systems (like the coupling of oscillating metronomes), chemical systems (with waves of color spiraling out in the Belousov-Zhabotinsky reaction), biological systems (with the pulsing of fireflies moving from chaotic to coordinated), to the interaction of human and mechanical systems (such as the near collapse of London's Millennium Bridge) (Muller & Lebedev, 2021; S. Strogatz, 2015).

In the managerial fads described above, disjointed individuals in an organization 'sync up' and being to both espouse or follow a specific managerial practice or fad. However, in short order, a new fad takes its place.

The choice between these two frameworks may seem obvious to one reader, while another may have very different view. This difference likely arises in the underlying assumption each reader is making about what is the fundamental problem this model is trying to address. Managerial fads as defined here are assumed to be costly, but what exactly do we mean by 'fad' aside from the general qualitative description given above?

This paper serves three purposes: the first is to provide a structural theory about the emergence of managerial fads in the more traditional System Dynamics approach and illustrate how similar behavioral outcomes could be illustrated using methods used in other natural and physical sciences concerned with similar synchronization phenomena. The second, and most important, is to illustrate how the applicability of either approach is fundamentally a function of the initial problem definition. Finally, this work also introduces the mathematical concepts of synchronization to the System Dynamics community as another fundamental modeling structure that can be built and expanded upon with additional behavioral contexts.

## 2. A Structural Theory of Managerial Fads Built from Qualitative Insights

To begin, this paper builds a structural theory of managerial fads from underlying qualitative and organizational social theory. For this structural model, we hypothesize that managers are rewarded, both in terms of compensation and in terms of reputation, in part by introducing novel management practices that spread through an organization (e.g., rewarded for being 'first' to successfully innovate). Furthermore, managers may receive some relative reward by adopting and advocating these new practices in their own teams as more and more of the firm adopts (e.g. rewarded for following 'best' practices as they are generally accepted by the firm).

Additionally managers are not only decision makers but also fundamentally people and subject to social pressures as well. Managers interact with others and can view their fellow leaders as either advocating/championing a specific process, or note that those around them are actively disillusioned and searching for a replacement process.

However, the rewards for adopting 'new' practices dilute over time as more of the firm also adopts, and correspondingly the perceived reward for defecting and discovering the 'next new' process begins to increase. Rather than continuing to advocate the existing managerial process, the promise of reward for new process discovery, and increasingly seeing other managers search, causes more and more defections from the current process.

### 2.1. A Coupled SI Model of Managerial Fads

A System Dynamics practitioner may recognize the above dynamic hypothesis as the beginnings of a set of coupled SI models or Bass Diffusion models (Sterman, 2000). In this structural model, Managers can exist in one of three states: Neutral Managers, Championing Managers, or Disillusioned Managers. The flow between Neutral Managers and Championing Managers follows the classic SI-model formulation, with contacts between Neutral and Championing Managers driving adoption of the 'new' process, based on an effective adoption fraction.

Similarly, Championing Mangers are interacting with Disillusioned Managers, and have a similar chance of abandoning their current process. Finally, it is assumed that after some average time Disillusioned Managers become susceptible again to adopting new managerial processes and return to the stock of Neutral Managers. This core dynamic is shown in Figure 1.

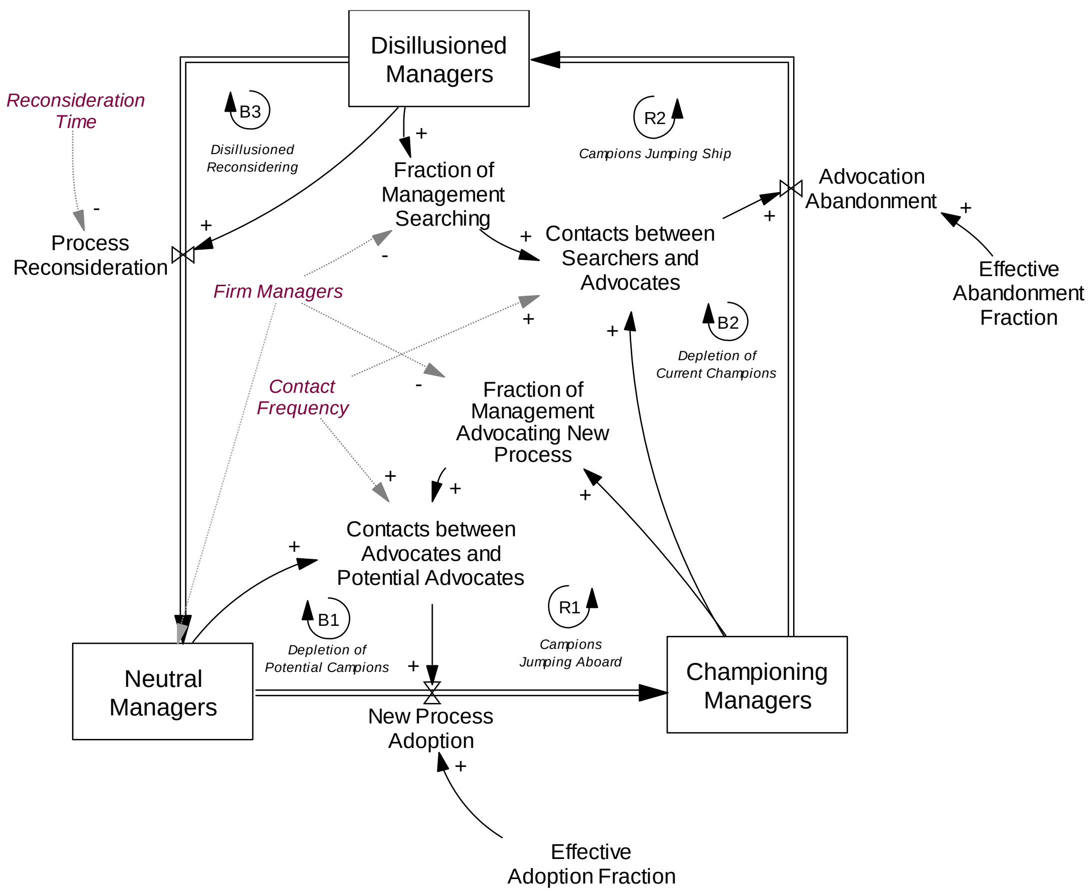


**Figure 1. Core Coupled SI Model of Managerial Fads**

The *Effective Adoption Fraction* in Figure 1 is not exogenous, but as described in the dynamic hypothesis that opened this section, a function of the perceived reward of adopting a new process. As discussed above, as the *Fraction of Management Advocating a New Process* increases and approaches 1, the expected relative reward for advocating that new process will decrease (e.g., the 'new' process becomes standard, so the reward for being a champion statutes). Similarly, as that fraction using this 'new' system saturates, the possible reward for discovering the 'next new' process increases. This is illustrated in Figure 2.

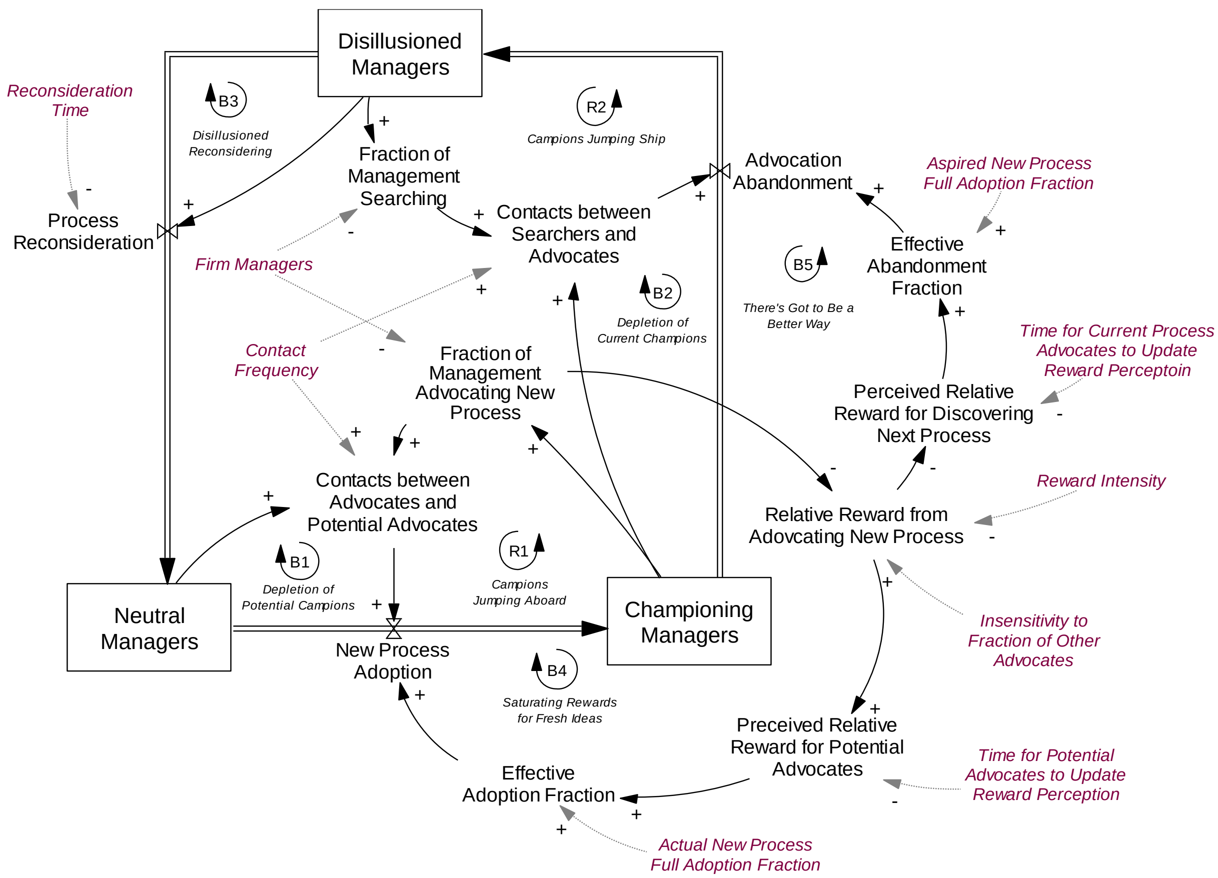


**Figure 2. Full Structural Model for Managerial Fads**

To capture the opposing and saturating nature of the rewards described above, expressions (1) and (2) are used, where $\pi_{advocacy}$ is the *Relative Reward from Advocating New Process* and *f* is the *Fraction of management Advocating New Processes* in Figure 2. $\pi_{search}$ is the relative reward for discovering the next new process and is assumed to simply be the complement of $\pi_{advocacy}$.

$$\pi_{advocacy} = e^{-max\left(0,\lambda * f - \frac{S_c}{f}\right)} \quad (1)$$

$$\pi_{search} = 1 - \pi_{advocacy} \quad (2)$$

The above expressions introduce $S_c$ which is the *Insensitivity to Fraction of Other Advocates*, and $\lambda$ which is the *Reward Intensity* in Figure 2. Higher values of $S_c$ provide a plateau of minimal fraction of management advocating a new policy that will still have the full reward for neutral managers, while the interaction with $\lambda$ controls how quickly rewards change past this minimum. Figure 3 illustrates expressions (1) and (2) with $\lambda = 4$ and $S_c = 0.25$.

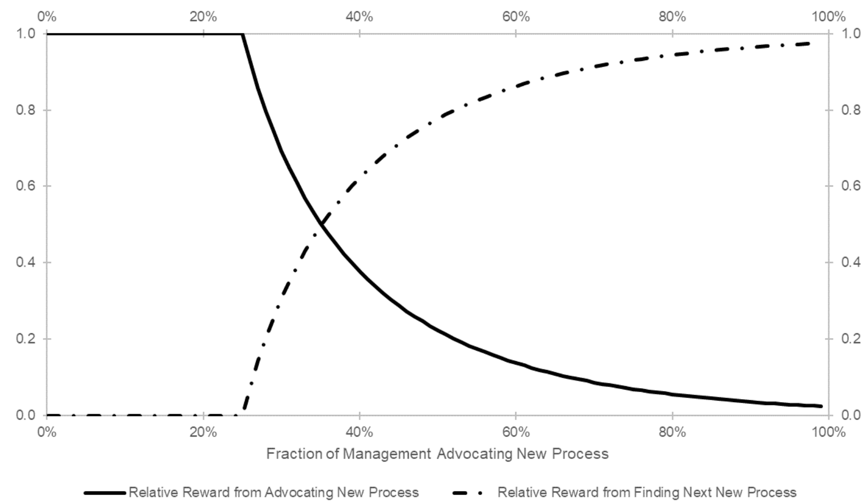


**Figure 3. Reward Structure Illustration**

Combined, this is the structural theory for the managerial fad behavior described in the opening of this paper. The full documented model is provided alongside this paper.

## 2.2. Calibrating to Cyclic Fads

The above model was tuned in order to generate repeated cycles of managers moving into and out of the *Championing* state. The values of these parameters are seen in Table 1.

**Table 1. Baseline Values of Tuned Cyclic Model**

| Parameter | Baseline Value | Units |
|---|---|---|
| Firm Managers | 100 | Managers |
| Initial Disillusioned Managers | 1 | Manager |
| Initial Process Champions | 60 | Managers |
| Contact Frequency | 5 | 1/Month |
| Reconsideration Time | 2 | Months |
| Reward Intensity | 2 | Dmnl |
| Insensitivity to Fraction of Other Advocates | 1 | Dmnl |
| Actual New Process Full Adoption Fraction | 0.05 | Dmnl |
| Aspired New Process Full Adoption Fraction | 1.00 | Dmnl |
| Time for Current Process Advocates to Update Reward Perception | 24 | Months |
| Time for Potential Advocates to Update Reward Perception | 10 | Months |

As seen in Figure 4, this parameterization generates repeated strong and rapid adoption of a new process (as about 20% of managers who are Champions of a new process swells to over 90%), to rapid abandonment, before repeating (presumably here with a new process).

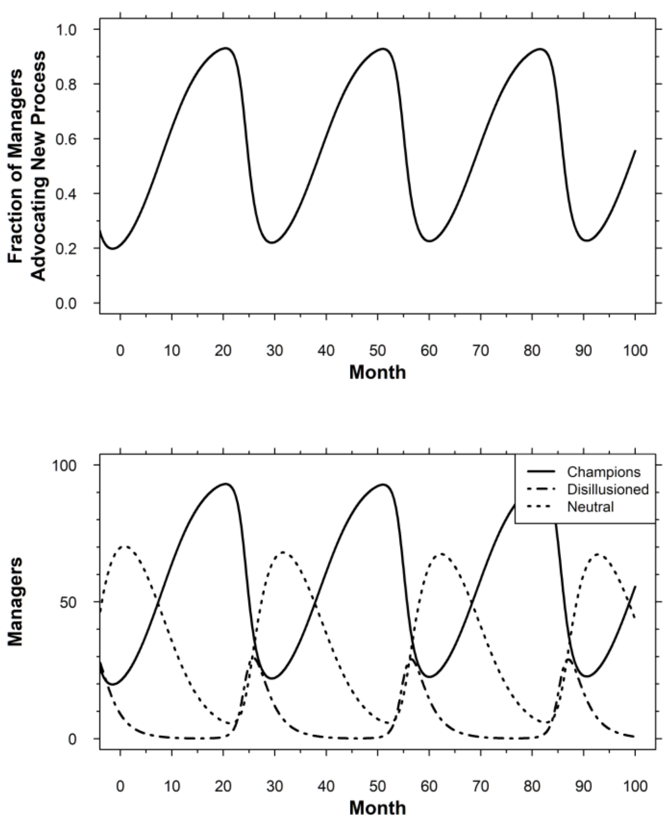


**Figure 4. Base Model Cyclic Process Adoption**

Examination of the parameter values in Table 1 help illustrate *why* this repeated cyclic behavior occurs here. Specifically, this baseline reward structure is relatively (but not totally) flat, as indicated by $\lambda = 2$ and $S_c = 1$. The value of championing, and thus adopting, a new process is held high until over 70% of the population of managers are champions, and only then does the appeal of finding a new process begin to rise. The actual reward for outright abandoning the current process only exceeds the rewards of adoption sometime after 90% adoption with this parameterization as seen in Figure 5.

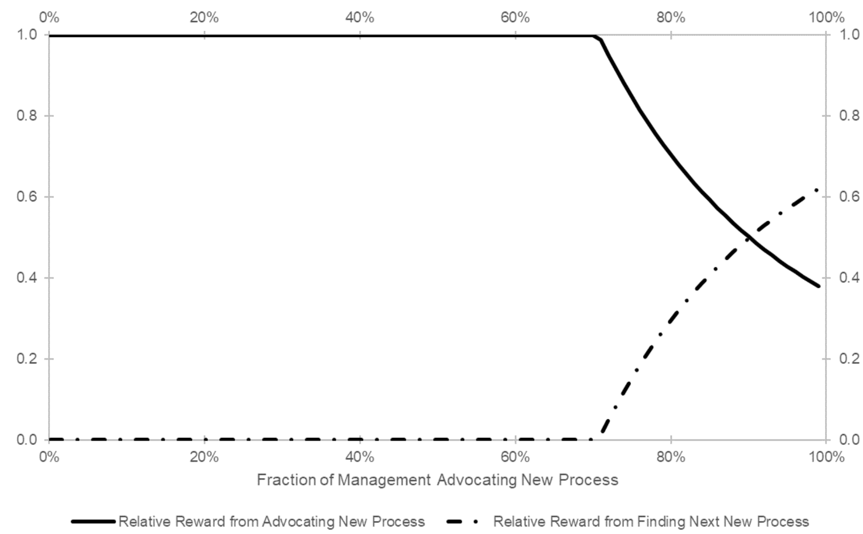


**Figure 5. Reward Structure for Cyclic Process Adoption**

Additionally, the *Actual New Process Full Adoption Fraction* (at a value of 0.05), which is the underlying rate at which interactions between Champions and Neutral managers result in adoption is significantly less than the *Aspired New Process Full Adoption Fraction* (at a value of 1.0). This aspired new process adoption fraction is what the managers imagine their new hypothetical process could achieve. In other words, this is extremely misbalanced set of parameters is capturing the mental model of “There has **got** to be a better way,” or alternatively a version of “If I build it, they will come.”

### 2.3. Policy Implied by the Calibrated Structural Model

A key assumption here for policy setting is that these cycling processes are costly, however some degree of exploration is assumed to also be beneficial. Thus, a policy that maintains some *stable* population of Neutral, Championing, and Disillusioned managers (and preferably in that order with decreasing population sizes) is assumed preferable. The above calibration helps imply some of the features of such a policy.

Consider first the very different sized values of *Actual New Process Full Adoption Fraction* and *Aspired New Process Full Adoption Fraction* in Table 1. Figure 6 shows a sensitivity analysis of the model to lower values of *Aspired New Process Full Adoption Fraction*, keeping all other values fixed as in Table 1. Lower values, more closely matching the actual adoption fraction new processes receive, help reduce unrealistic expectations and are stabilizing. Note that these 'more realistic expectations' can still be three times higher than reality and still result in get stable outcomes as parametrized here.

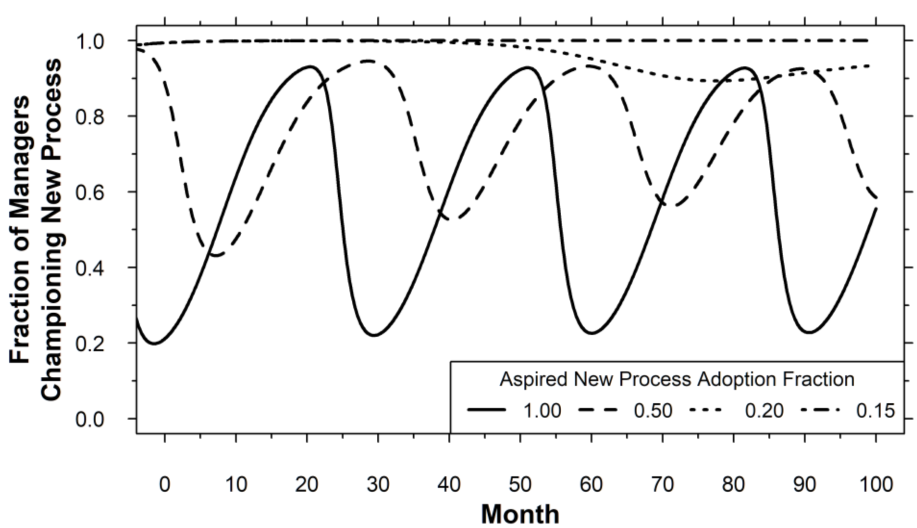


**Figure 6. Sensitivity to *Aspired New Process Full Adoption Fraction***

Similarly, the shape of the reward policy can affect stability. The shape of the policy results from the interplay of both $\lambda$ and $S_c$ in expressions (1) and (2) but consider holding $S_c$ constant and decreasing the *Reward Intensity* ($\lambda$) as is done in Figure 7. Flattening the reward function reduces the reward for becoming disillusioned while maintaining the reward for adopting in the first place, and is ultimately stabilizing.

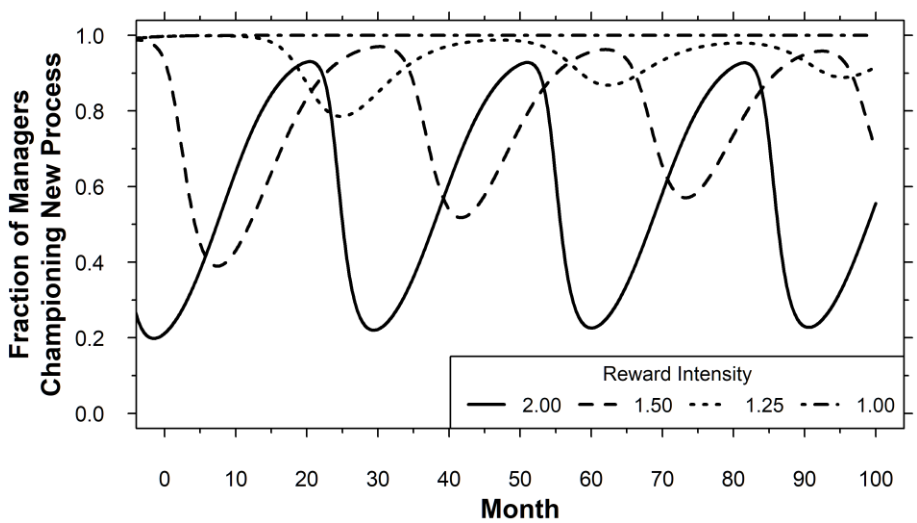


**Figure 7. Sensitivity to *Reward Intensity* (λ)**

The simple sensitivity analyses shown in Figure 6 and Figure 7 show paths towards stable outcomes but do so by forcing all managers into a *Championing* state. As stated at the beginning of this section, it is assumed that there is some value in a mix of states, allowing for exploration of new policies while not having the wild cyclic processes show in the baseline case above. To achieve this long run stable but mixed outcome, consider the parameterization shown alongside the baseline values in Table 2. Figure 8 shows the long-run stable mixing that results.

**Table 2. Baseline Cyclic vs Long-Run Stable Parameter Values**

| Parameter | Baseline Cyclic | Long-Run Stable | Units |
|---|---|---|---|
| Firm Managers | 100 | 100 | Managers |
| Initial Disillusioned Managers | 1 | 1 | Manager |
| Initial Process Champions | 60 | 60 | Managers |
| Contact Frequency | 5 | 5 | 1/Month |
| Reconsideration Time | 2 | 2 | Months |
| Reward Intensity | 2 | 20 | Dmnl |
| Insensitivity to Fraction of Other Advocates | 1 | 1 | Dmnl |
| Actual New Process Full Adoption Fraction | 0.05 | 0.05 | Dmnl |
| Aspired New Process Full Adoption Fraction | 1 | 1 | Dmnl |
| Time for Current Process Advocates to Update Reward Perception | 24 | 24 | Months |
| Time for Potential Advocates to Update Reward Perception | 10 | 3 | Months |

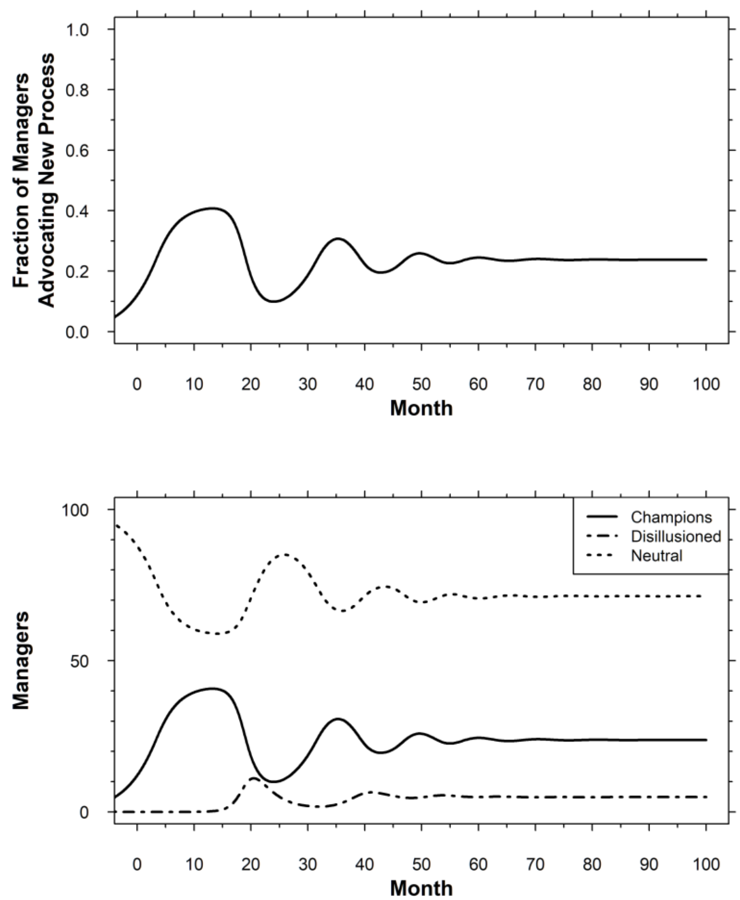


**Figure 8. Stable Long-Run Mixing in Adoption**

Investigation of the parameters in Table 2 show two parameter changes, *Reward Intensity* is increased from 2 to 20, and *Time for Potential Advocates to Update Reward Perception* is reduced from 10 to 3. For the time constant, this increases the gap in perception times between becoming disillusioned and becoming a champion.

However more importantly is the large increase in *Reward Intensity*. This creates a reward function seen in Figure 9, which is nearly step-like in its behavior. Under this reward structure, the reward for ‘being first’ to adopt a new process, while still present, drops off quickly.

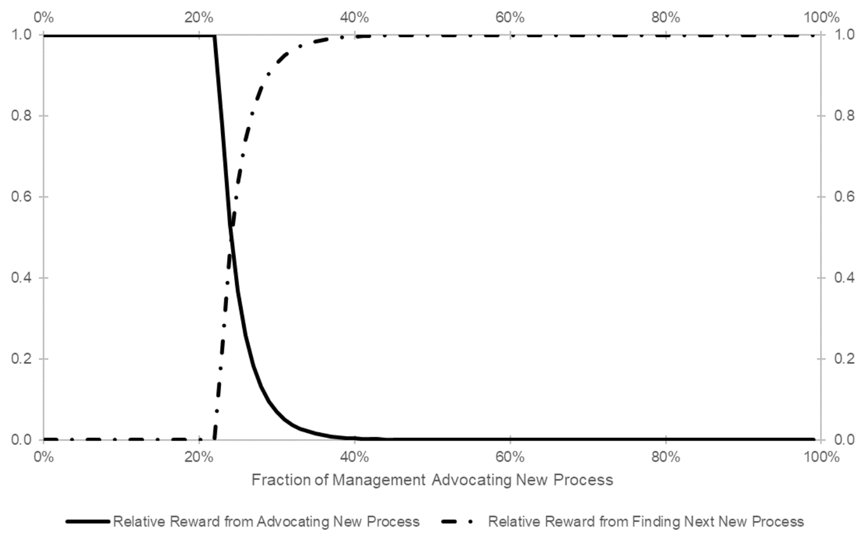


**Figure 9. Reward Structure for Stable Long-Run Mixing in Adoption**

The combination of these parameters maintains some of the “There’s got to be a better way” mental model of the baseline model, which encourages a continuous background level of exploration, while calibrating the reward structure to still encourage process champions to emerge as well. The net result is a firm in which about 70% of the managers are working at the existing process, 25% are actively championing the adoption of a new process, and 5% are actively disengaged with either process. This is not only a good balance of exploration and exploitation, arguably, but also stable in steady state.

## 3. A Model of Managerial Fads Built from Synchronization Theory

The structural model developed above started with qualitative insights on the different types of managers in a hypothetical firm and consideration of their reward structure. While this is grounded in observations in organizational behavior, it raises questions about the validity of such a model in other contexts. How applicable are the policy implications that were arrived at in the prior section to broader classes of problems? Generally, we model a problem, not a system (Sterman, 2000) so this concern about wider external validity may not be appropriate, or could even be distracting. However, the use of fundamental units of modeling structure, or molecules, with a large degree of external validity across contexts has been useful (Hines, 2005), and indeed the above structural example builds on a smaller oft SI modeling framework.

As an extension of this molecule approach, consider the arguably opposite of the hyper-context dependent structural model approach considered above, that instead starts with a generic mathematical object that we can contextually adapt.

The managerial fad phenomena that motivate this work is based on a series of individuals or groups coalescing around a single idea or concept, often in rapid succession. While the above structural model categorized three types of managers with diverse levels of engagement, it does not capture the concept of multiple management styles or fads developing and competing with each other simultaneously.

As described in the introduction to this article, the concepts of synchronization have been explored in many settings, including behavioral and physical. A simple mathematical model that captures synchronization amongst oscillating groups, much like the oscillating context of managerial fads explored here, is the Kuramoto model (Acebrón et al., 2005; Kuramoto, 1975, 1984; S. H. Strogatz, 2000).

In this model, a given oscillator *i* is assumed to have an intrinsic frequency $\omega_i$. Mapping to the conceptual space here, we could consider a management theory framework like that of Peter Drucker (Drucker, 2018) which decomposes management styles across four ‘pillars’. Consider that over time the manager will intrinsically move along combinations of the two of these pillars, such as decentralization (from fully autonomous versus fully autocratic) and prioritization of knowledge work (from highly mechanical task orientation to highly abstract strategy orientation).

In the Kuramoto model, all oscillators (here managers or subsets of the firm with similar characteristics), are coupled and influenced by where each other. $\theta$ is the angle on the unit circle formed by the two dimensions of management being considered, and the change in $\theta$ for an individual or group in the firm is determined by the natural frequency $\omega$, the strength of coupling between individuals $K$, and the conceptual distances between the individual and the others in the organization.

$$\frac{d\theta_i}{dt} = \omega_i + \frac{K}{N}\sum_{j=1}^{N} \sin\left(\theta_j - \theta_i\right), \qquad i = 1 \dots . N \tag{3}$$

This model presupposes that processing along the complex combinations of these two dimensions is a natural an ongoing process. In other words, using the language of this context, those in the firm are assumed to change their management style over time. Rather than exploring how to *stop* this procession, this model allows us to explore how individuals or subgroups within the firm differ from one another over time, and how many subgroups may exist at any one time. This is a subtle but important difference in the definition of 'fad' from the first structural analysis in this paper. This approach is extremely parsimonious with only one driving expression, versus the many more that underpin the structural model developed above. It risks being too divorced from the context of the original problem, and prior work has shown that abstracting away from the physical reality of a problem can lead to serious issues with the external validity of policy recommendations under some circumstances (Olaya, 2012).

This is not necessarily 'better' or 'worse' than the prior structural framing, simply different. Starting from a general mathematical framework is presented here in part to illustrate the different policies that emerge, and to provide another example of a molecule of structure (here a generalized mathematical model of synchronicity) for use in the System Dynamics community.

For the examples explored here, the baseline values shown in Table 3 are used.

**Table 3. Baseline Values of the Kuramoto Synchronization Model**

| Parameter | Value |
|---|---|
| Number of Oscillators/Managers (N) | 10 |
| Coupling strength (K) | 2 |
| Natural frequency ($\omega$) | 0.2 |

In this baseline with *N=10* oscillators placed equidistant around the unit circle, the system quickly collapses down to all 10 overlapping and processing around the circle together. In other words, in this baseline example, perfect synchronization quickly forms. In the context of an organization, this would map with 10 managers or subgroups who initially have 10 different ideas of the ideal complex combination of features that form a management policy should be enacted. However, over short period of time, all 10 coalesce around each other, and while the fundamental features of their management style shift over time, they do so in total sync. Figure 10 shows samples of this behavior over time. Note that for all the figures in this section, animations are available in the supplement.

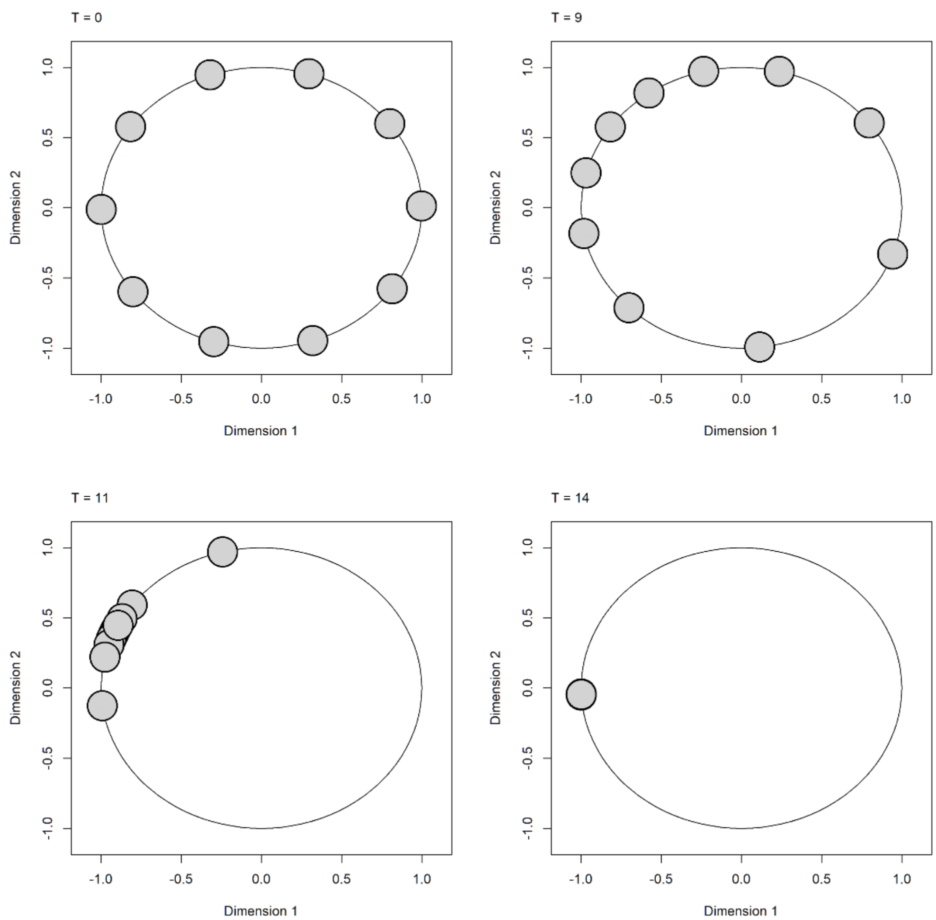


**Figure 10. Rapid Synchronization from Equidistance with No Noise**

## 3.1. A Synchronization Model with Imperfect Information Visibility

The Kuramoto model shown in expression (3) will eventually either collapse into synchronization, or alternatively remain unsynchronized or chaotic. However, one of the key drivers of the evolution of this system is the distance between oscillators (the $\theta_j - \theta_i$ term in expression (3)). Applying more behavioral context to this otherwise low-context mathematical framework, we can instead use the *perceived* distance to drive the evolution of managerial practices. This relies on concepts that follow from other sociological frameworks such as the Baker Criterion which require that decisions be made using only that information that is actually observable to the decision maker (Sterman, 2000).

It is reasonable to extend the model in expression (3) by considering that a manager in this system would update based on a delay in the perception of others position in the space. Alternatively, or in addition, the manager could imperfectly view the position of others in the space. This is reasonable insomuch as the specifics of a managerial policy are complex, even in this simplified two dimensional setting, and constantly evolving.

For the examples below, we consider the effect of imperfect and noisy perceptions of the distances between others. For this modification, the actual distance is modified by a mean-zero normally drawn error term as shown in expression (4).

$$\frac{d\theta_i}{dt} = \omega_i + \frac{K}{N}\sum_{j=1}^{N} \sin\left(\theta_j - \theta_i + \epsilon_i\right), \qquad \epsilon_i \in \mathbb{N}(0, \sigma) \tag{4}$$

First, consider noise $\epsilon_i \in \mathbb{N}(0, \sigma)$ with standard deviation of $\pi/2$ . In the context of this two dimensional system, means that the standard deviation of the noise term is equal to plus or minus one quarter of the unit circle. Figure 11 show selected points along the evolution of this system (again, animations are available in the supplement).

As seen in Figure 11, this system still converges on a sort of synchronization, but with more spread amongst the individual members. In other words, agreement is not uniform.

Additionally, this synchronization takes significantly longer to form versus the case with no noise.

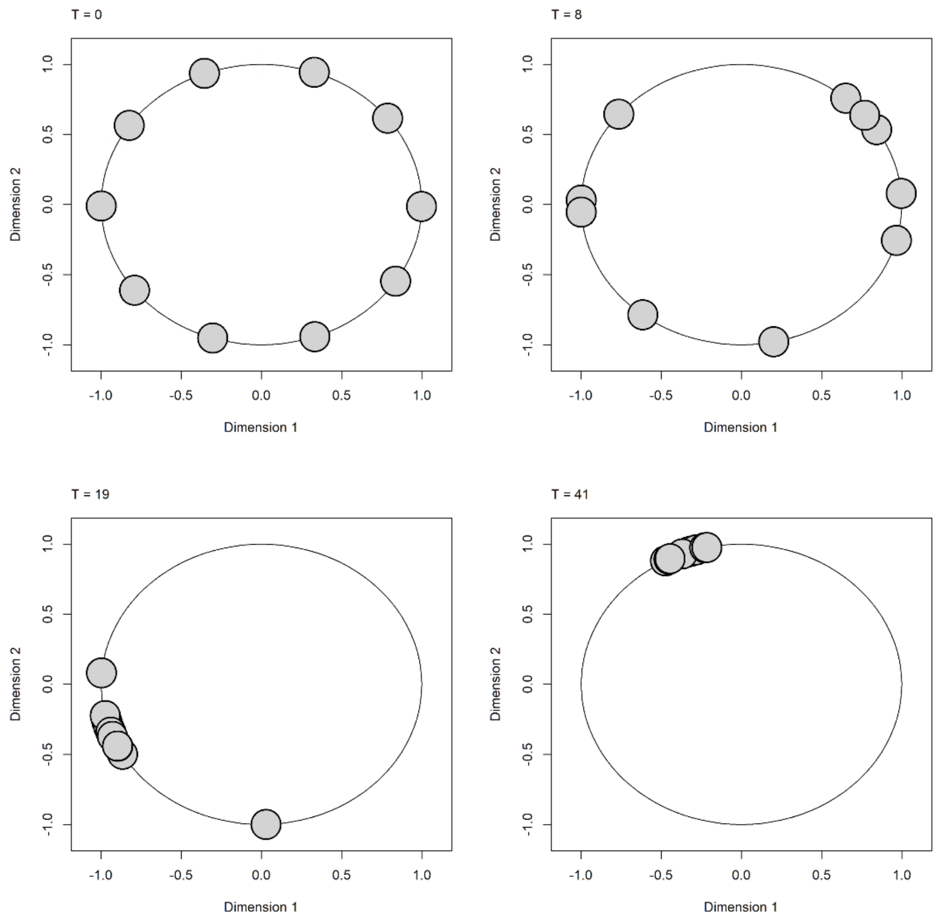


**Figure 11. Slower Synchronization from Equidistance with $\sigma = \pi/2$**

When noise $\epsilon_i \in \mathbb{N}(0, \sigma)$ is increased to a value of $\pi$, as seen in Figure 12, the behavior as parameterized here fundamentally changes. Here, synchronization into subgroups occurs, but loosely, with a core membership of one or two individuals across three larger subgroups and others moving between those groups. Within these groups, synchronization is not total but instead loose, and the subgroups themselves continue to process along the unit circle.

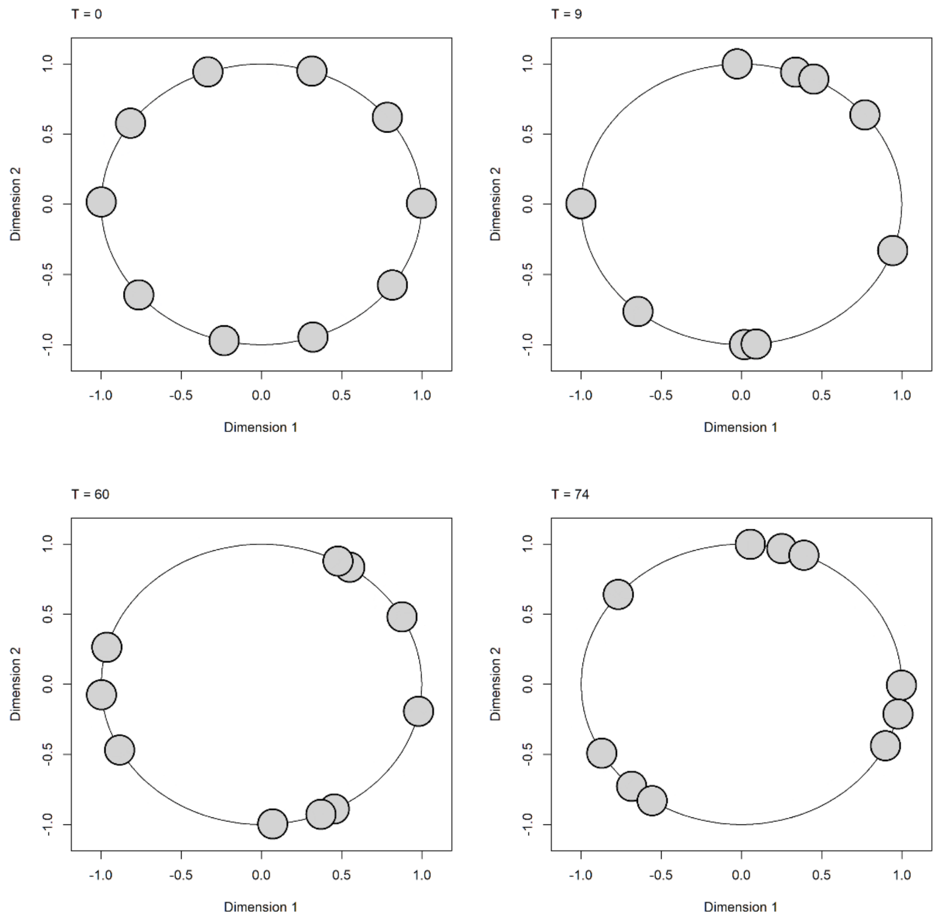


**Figure 12. Mixed Groups of Synchronization from Equidistance with $\sigma = \pi$**

This behavior matches the concept competing fads within organizations, competing for membership while still evolving themselves. Here it is not the specific details of the management styles or fads that matter (like the prior structural model), but rather the number of completing sub-organizations that emerges.

Similarly, consider a system that is not started with equidistant members, but rather with members that begin in total agreement, processing along in synchronization at the same starting point and fundamental frequency on the unit circle. When parameterized as in Table 3 and governed by expression (3) with no noise, the system is simply a set of 10 managers, all with the exact same style, all evolving together over time.

However, when injecting enough noise versus the Coupling Strength parameter *K*, this system can show *desynchronization* from initial agreement, eventually coalescing into subgroups seen in the prior analysis, albeit with some very dominate in size versus the others.

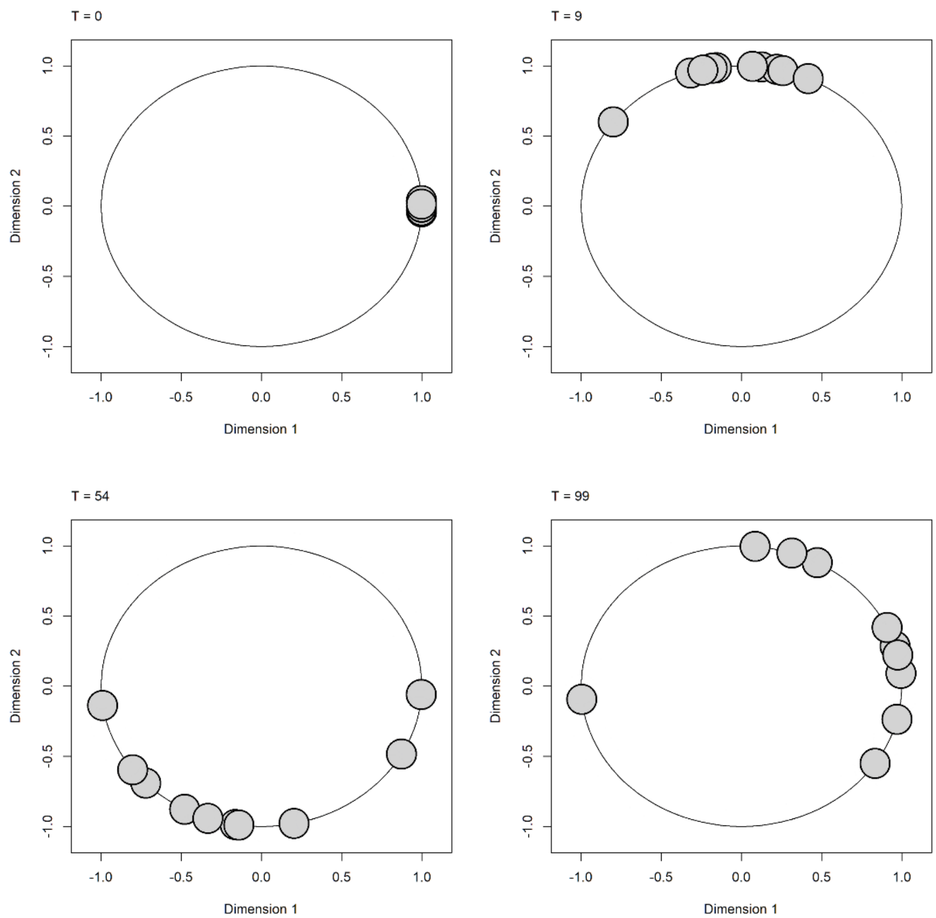


**Figure 13. Mixed Groups of Synchronization from Clustered Start with $\sigma = 3\pi/2$**

## 3.2. Policy Implied by the Noisy Synchronization Model

The policy analysis in the dynamic Kuramoto model emerges from similar sensitivity analysis performed in the structural model above. Much of this sensitivity analysis was done alongside the presentation of the main model in the prior sections, and indicates how imperfect perceptions of the position of others can yield both a greater spread in the details of managerial practices, and also the emergence of distinct subgroups of managerial practices in an organization.

What is interesting is that the effect of this imperfect perception yielding the emergence of subgroups is not necessarily dependent on the fundamental frequency $\omega$ of the oscillators. This frequency is the underlying tendency for a manager to naturally change her management style along the dimensions considered here. However, one could argue that a manger *does not* naturally change practices and instead will stick with a specific complex combination of practices unless externally stressed. In other words, $\omega_i = 0,\ \forall i$.

For this scenario, with perfect noiseless perception of the position of others, and in the situation where every manager starts equidistant around the unit circle, by inspection of expression (3) the position of each manger will not change no matter the size of the coupling coefficient. However, with just the slightest amount of non-zero noise (e.g. $\sigma > 0$ in expression (4)) or even slightly non-perfectly equidistant initial spacing, the system quickly collapses into a single synchronous point, though one that does not process around the unit circle.

With enough noise however, subgroups emerge as in the prior examples. While still dynamic over time, with variations in their core complex combinations of the dimensions that make up their managerial practices, these groups do not necessarily process around the unit circle. In other words, with enough noise in perceptions, managers in this model will not only form subgroups but those groups will continuously modify their underlying managerial practices over time even with no underlying natural frequency.

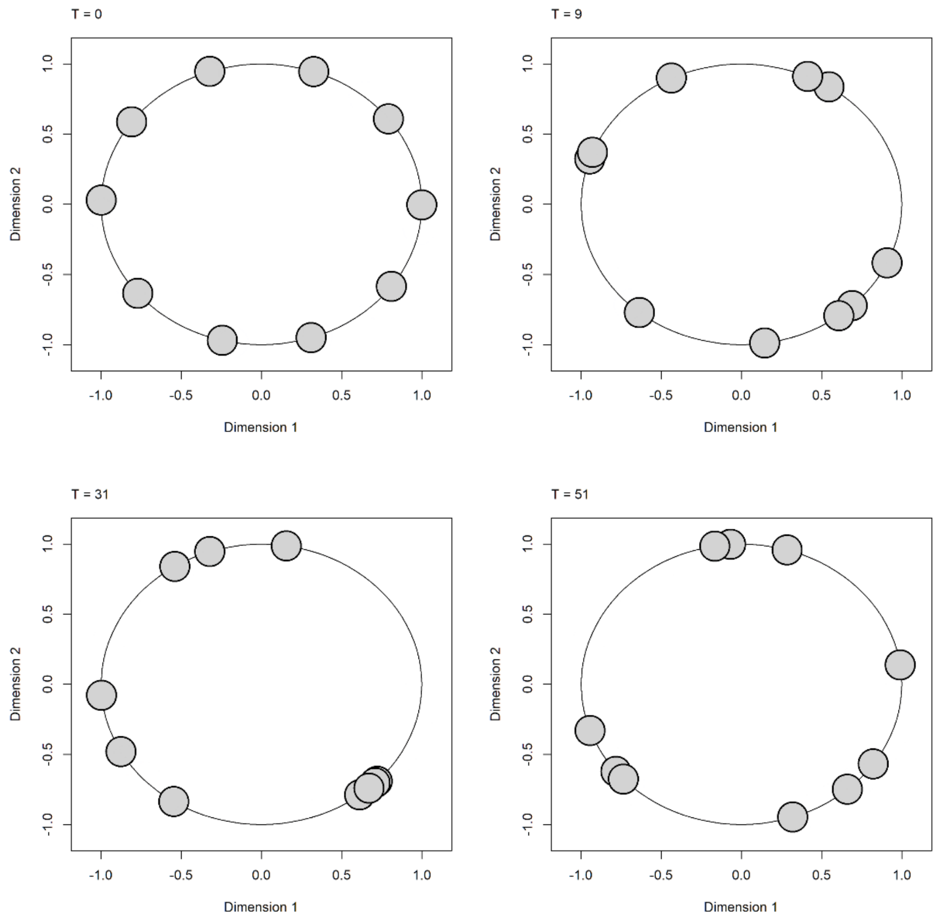


**Figure 14. Mixed Groups of Synchronization from Equidistant Start with $\omega = 0$ and $\sigma = \pi$**

In terms of additional policy implications, this begs two questions: is this subgroup clustering and is the continuous procession around the unit circle desirable for the firm? One could easily imagine that too much change in managerial practices could be costly, as hypothesized as part of the analysis for the structural model above. However, some degree of exploration and updating of policies could also be beneficial, resulting in the stable mixing policy explored in that prior section as well.

Under the assumption that there is 'one best' managerial policy to follow, the Kuramoto model implies first and foremost a policy of low to negligible noise $\sigma$ with some moderate coupling *K*. If a stable set of practices is desired that does not change over time then $\omega$ should be kept low. Mapping these mathematical terms to managerial concepts, this would encourage a firm to have extremely open communication and a 'winner takes all' approach to policy formation. New ideas are quickly vetted and discarded and once a dominate idea emerges, it is adopted and stuck with.

Under the assumption that some exploration is beneficial but that excessive change in underlying managerial practices is possibly harmful, the Kuramoto model implies a policy of low to negligible $\omega$ with some moderate coupling $K$, combined with moderate to high noise $\sigma$. Mapping these mathematical terms to managerial concepts, this would encourage a firm to have some degree of siloing, with imperfect information availability between those silos, but some visibility to still occur. Within those silos, specific managerial practices are dominate, but not totally static, and the practices elsewhere in the firm do provide some influence. This would allow for (presumably) best practices to proliferate while minimizing the degree of internal turmoil from excessive policy and practice changes.

## 4. Further Discussion

While the motivating story of this article is investigating the emergence of managerial fads, it in reality provides a comparison of two fundamentally different approaches to modeling a problem and suggesting policy.

One starts small and builds up by taking a structural approach based on building a model from combining pieces of organizational theory and behavioral hypotheses. The other starts general and then narrows to a specific context by taking a generalized mathematical framework and adding behaviorally implied modifications. Both provide examples of using fundamental structures (the SI model in the structural model case and the Kuramoto model in the mathematical model case) as the basis for a more context-specific application.

Both imply different policy levers to influence the system, which emerge from the different features of each approach.

Prior work has stated that abstracting too far away from the operational context of a problem can reduce the external validity of the model (Olaya, 2012). However, it could also be argued that providing *too much* operational context can make a model brittle to any other context. Neither of the two approaches here are not necessarily more operationally grounded than the other, but rather provide different models to two sets of related, but different, problems. This helps illustrate the often overlooked, and arguably most important, question in model formation: “'What problem are you trying to solve?” (Repenning et al., 2017).

Addressing ‘managerial fads’ generally is to model a system, not a problem. Is the problem the cyclic nature of support for specific initiatives? In that case, the structural model presented here is the better choice. However, is the problem the emergence of ‘group think’ around a specific idea with near continuous changes in what that single agreed upon ‘right answer’ is? In that case, the modified Kuramoto model is much more applicable. In net, simply first stating that the emergence of managerial fads is a problem is insufficient and must first be further defined before an appropriate modeling framework can even be chosen, let alone building a model itself.

While this work does endeavor to provide some insights on managerial fad formation and policies, it foremost strives to illustrate how the choice of modeling framework influences policy recommendations and encourages modelers to first clarify the specific problem they are trying to solve.

## 5. References


Acebrón, J. A., Bonilla, L. L., Pérez Vicente, C. J., Ritort, F., & Spigler, R. (2005). The Kuramoto model: A simple paradigm for synchronization phenomena. *Rev. Mod. Phys.*, *77*(1), 137–185. https://doi.org/10.1103/RevModPhys.77.137

Drucker, P. F. (2018). *The Essential Drucker* (1st ed.). Routledge. https://doi.org/10.4324/9780080939322

Hines, J. (2005). *Molecules of Structure: Building Blocks for System Dynamics Models Version 2.02*. Sloan School of Management.

Kuramoto, Y. (1975). Self-entrainment of a population of coupled non-linear oscillators. In H. Araki (Ed.), *International Symposium on Mathematical Problems in Theoretical Physics* (Vol. 39, pp. 420–422). Springer-Verlag. https://doi.org/10.1007/BFb0013365

Kuramoto, Y. (1984). *Chemical Oscillations, Waves, and Turbulence* (Vol. 19). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-69689-3

Muller, D., & Lebedev, P. (Directors). (2021, March 31). The Surprising Secret of Synchronization. In *Veritasium*. https://www.youtube.com/watch?v=t-_VPRCtiUg

Olaya, C. (2012). Models that Include Cows: The Significance of Operational Thinking. *30th International Conference on System Dynamics Society*, 1–19.

Oliva, R., Rockart, S., & Sterman, J. (1998). Managing multiple improvement efforts: Lessons from a semiconductor manufacturing site. In D. Fedor & S. Ghosh (Eds.), *Advances in the Management of Organizational Quality* (Vol. 3, pp. 1–55). JAI Press.

Paine, J. (2022). Applying an Endogenized PID Controller Design to Speculative Bubble Formation. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4137800

Repenning, N. P., Kieffer, D., & Astor, T. (2017). The most underrated skill in management. *MIT Sloan Management Review*, *58*(3), 39–48.

Sterman, J. (2000). *Business Dynamics: Systems Thinking and Modeling for a Complex World* (1st ed.). Irwin/McGraw-Hill.

Strogatz, S. (2015). *Sync: How order emerges from chaos in the universe, nature, and daily life* (First Hachette Books trade edition). Hachette Books.

Strogatz, S. H. (2000). From Kuramoto to Crawford: Exploring the onset of synchronization in populations of coupled oscillators. *Physica D: Nonlinear Phenomena*, *143*(1–4), 1–20. https://doi.org/10.1016/S0167-2789(00)00094-4