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Chapter 1 : Reliability-centered Maintenance Training - Failure Prevention Associates, LLC

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Natural events like earthquakes or storms may initiate a complex system failure. But this masks the underlying causes of an incident. It is more helpful to consider the site of the incident as a spectacle of mismanagement. Responsibility for an incident, in most cases, can be attributed to a senior management decision e. What decisions led to a situation where front line operators were unprepared or untrained to respond to an incident and mishandled it? To safeguard against failures, standards and practices have evolved in many industries that encompass strict criteria and requirements for the design and operation of systems, often including inspection regimens and certifications. Compiled, codified, and enforced by agencies and entities in each industry, these programs and requirements help protect the service user from the bodily injuries or financial effects of failures and spur industries to maintain preparedness and best practices. Twenty years of Uptime Institute research into the causes of data center incidents places predominant accountability for failures at the management level and finds only single-digit percentages of spontaneous equipment failure. This fundamental and permanent truth compelled the Uptime Institute to step further into standards and certifications that were unique to the data center and IT industry. Uptime Institute undertook a collaborative approach with a variety of stakeholders to develop outcome-based criteria that would be lasting and developed by and for the industry. The Deepwater Horizon oil spill. DC air crashes in the s. The Three Mile Island nuclear release. Battery fires in Boeing s. The space shuttle Challenger disaster. Fukushima Daiichi nuclear disaster. The grounding of the Kulluk arctic drilling rig. These are a few of the most infamous, and in some cases tragic, engineering system failures in history. All exemplify highly complex systems operating in technologically sophisticated industries. Large systems and the industries that use them have many safeguards against failure and multiple layers of protection and backup. Thus, when they fail it is due to much more than a single element or mistake. It is a truism that complex systems tend to fail in complex ways. Looking at just a few examples from various industries, again and again we see that it was not a single factor but the compound effect of multiple factors that disrupted these sophisticated systems. If this increased load is too great, it can cause other nodes to overload and fail as well, creating a waterfall effect as every component failure increases the load on the other, already stressed components. The following transferable concept is drawn from the power industry: Power transmission systems are heterogeneous networks of large numbers of components that interact in diverse ways. The effects of the component failure can be local or can involve components far away, so that the loading of many other components throughout the network is increasedâ€¦ the flows all over the network change Dobson, et al. A component of the network can be mechanical, structural or human agent, as front-line operators respond to an emerging crisis. Just as engineering components can fail when overloaded, so can human effectiveness and decision-making capacity diminish under duress. The sinking of the Titanic is perhaps the most well-known complex system failure in history. This disaster was caused by the compound effect of structural issues, management decisions, and operating mistakes that led to the tragic loss of 1, lives. Just a few of the critical contributing factors include design compromises e. And, of course, there was the hubris of believing the ship was unsinkable. Right A side-by-side comparison of an original Boeing Dreamliner battery compared and a damaged Japan Air Lines battery. Looking at a more recent example, the issue of battery fires in Japan Airlines JAL Boeing s, which came to light in see Figure 1 , was ultimately blamed on a combination of design, engineering, and process management shortfalls Gallagher Following its investigation, the U. The manufacturer failed to adequately account for the thermal runaway phenomenon: Called lithium dendrites, these deposits can cause a short circuit that reacts chemically with the battery cell, creating heat. Lithium dendrites occurred in wrinkles that were found in some of the battery electrolyte material, a manufacturing quality control issue. Some important factors were overlooked that should have been considered during safety assessment of the batteries. Certain entities made changes to the specifications and instructions without proper approval or oversight. How many of these circumstances parallel those that

can happen during the construction and operation of a data center? It is all too common to find deviations from as-designed systems during the construction process, inconsistent quality control oversight, and the use of multiple subcontractors. Insourced and outsourced resources may disregard or hurry past written procedures, documentation, and communication protocols search Avoiding Data Center Construction Problems journal. The greater the number of components and the higher the energy and heat levels, velocity, and size and weight of these components the greater the skill and teamwork required to plan, manage, and operate the systems safely. Between mechanical components and human actions, there are thousands of possible points where an error can occur and potentially trigger a chain of failures. Cook identifies and discusses 18 core elements of failure in complex systems: Complex systems are intrinsically hazardous systems. Complex systems are heavily and successfully defended against failure. Complex systems contain changing mixtures of failures latent within them. Complex systems run in degraded mode. Catastrophe is always just around the corner. Hindsight biases post-accident assessments of human performance. Human operators have dual roles: All practitioner actions are gambles. Actions at the sharp end resolve all ambiguity. Human practitioners are the adaptable element of complex systems. Human expertise in complex systems is constantly changing. Change introduces new forms of failure. Safety is a characteristic of systems and not of their components. People continuously create safety. Failure-free operations require experience with failure Cook Data center systems are defended from failure by a broad range of measures [Element 2], both technical e. Because of these multiple layers of protection, a catastrophic failure would require the breakdown of multiple systems or multiple individual points of failure [Element 3]. This is due to the progression over time of various factors including steadily increasing load demand, engineering forces, and economic factors. The enormous investments in data center and other highly available infrastructure systems perversely incents conditions of elevated risk and higher likelihood of failure. Maximizing capacity, increasing density, and hastening production from installed infrastructure improves the return on investment ROI on these major capital investments. The increasing density of data center infrastructure exemplifies the dynamics that continually and inexorably push a system towards critical failure. Server density is driven by a mixture of engineering forces advancements in server design and efficiency and economic pressures demand for more processing capacity without increasing facility footprint. Increased density then necessitates corresponding increases in the number of critical heating and cooling elements. Note that engineering improvements and load growth are driven by strong, underlying economic and societal forces that are not easily modified. For large-scale mission critical and business critical systems, the profound implication is that designers, system planners, and operators must acknowledge the potential for failure and build in safeguards. Human error is often cited as the root cause of many engineering system failures, yet it does not often cause a major disaster on its own. Based on analysis of 20 years of data center incidents, Uptime Institute holds that human error must signify management failure to drive change and improvement. Although front-line operator error may sometimes appear to cause an incident, a single mistake just like a single data center component failure is not often sufficient to bring down a large and robust complex system unless conditions are such that the system is already teetering on the edge of critical failure and has multiple underlying risk factors. For example, media reports after the Exxon Valdez oil spill zeroed in on the fact that the captain, Joseph Hazelwood, was not at the bridge at the time of the accident and accused him of drinking heavily that night. However, more measured assessments of the accident by the NTSB and others found that Exxon had consistently failed to supervise the captain or provide sufficient crew for necessary rest breaks see Figure 2. The picture was taken three days after the vessel grounded, just before a storm arrived. Perhaps even more critical was the lack of essential navigation systems: There was also inadequate disaster preparedness and an insufficient quantity of oil spill containment equipment in the region, despite the experiences of previous small oil spills. Cook points out, post-accident attribution to a root cause is fundamentally wrong [Element 7]. Complete failure requires multiple faults, thus attribution of blame to a single isolated element is myopic and, arguably, scapegoating. Exxon blamed Captain Hazelwood for the accident, and his share of the blame obscures the underlying mismanagement that led to the failure. Inadequate enforcement by the U. Coast Guard and other regulatory agencies further contributed to the disaster. As a result, the rig and its tow vessels undertook a challenging 1,nautical-mile journey across the icy and

storm-tossed waters of the Gulf of Alaska in December Funk There had already been a chain of engineering and inspection compromises and shortfalls surrounding the Kulluk, including the installation of used and uncertified tow shackles, a rushed refurbishment of the tow vessel Discovery, and electrical system issues with the other tow vessel, the Aivik, which had not been reported to the Coast Guard as required. Discovery experienced an exhaust system explosion and other mechanical issues in the following months. Gale-force winds put continual stress on the tow line and winches. The tow ship was captained on this trip by an inexperienced replacement, who seemingly mistook tow line tensile alarms set to go off when tension exceeded tons for another alarm that was known to be falsely annunciating. At one point the Aivik, in attempting to circle back and attach a new tow line, was swamped by a wave, sending water into the fuel pumps a problem that had previously been identified but not addressed , which caused the engines to begin to fail over the next several hours see Figure 3. Waves crash over the mobile offshore drilling unit Kulluk where it sits aground on the southeast side of Sitkalidak Island, Alaska, Jan. A Unified Command, consisting of the Coast Guard, federal, state, local and tribal partners and industry representatives was established in response to the grounding. Despite harrowing conditions, Coast Guard helicopters were eventually able to rescue the 18 crew members aboard the Kulluk. Valiant last-ditch tow attempts were made by the repaired Aivik and Coast Guard tugboat Alert, before the effort had to be abandoned and the oil rig was pushed aground by winds and currents. Topology require multiple, diverse independent distribution paths serving all critical equipment to allow maintenance activity without impacting critical load. The data center in this example had been designed appropriately with fuel pumps and engine- generator controls powered from multiple circuit panels. As built, however, a single panel powered both, whether due to implementation oversight or cost reduction measures. At issue is not the installer, but rather the quality of communications from the implementation team and the operations team.

Chapter 2 : Examining and Learning from Complex Systems Failures

Assembly tolerance analysis is a key element in industry for improving product quality and reducing overall cost. It provides a quantitative design tool for predicting the effects of manufacturing variation on performance and cost.

Process Control System Analysis 5. Miscellaneous Procedural Issues The involvement of the metrological engineer in the pre-design phase of product development will ensure that economical analysis is performed when assigning tolerancing to part features. Costs associated with excessively "tight" tolerancing can be astronomical from both the gaging and the manufacturing process perspective. The metrological engineer will have much needed early input into decisions affecting cost, availability, reliability and capability of measuring systems applied during the production planning phase of the product development cycle. Bhargava, Samir, Grant, B. Marion Taguchi Methods and Tolerance Assignment: A study of crankshaft bearing failure was conducted using surface metrology techniques in conjunction with a Taguchi designed engine test. Preliminary results indicated that the failure mode was not a function of surface roughness as was initially expected. Software was developed on a DOS based PC to acquire unfiltered total profile data from a surface profiling stylus instrument. The software also implements phase-correct Gaussian filtering, according to ISO TC57 draft standards 1,2,3, in a band pass configuration to isolate waviness from both roughness and form. With these tools, the effects of all three components of the surface profile; roughness, waviness and straightness form , could be isolated and evaluated separately. The Taguchi ANOVA results indicated that the failure mode was strongly correlated to waviness Wt-evaluated using ISO band-pass Gaussian filtering , but weakly or not correlated to any aspect of roughness or straightness. The specification for the crank pin and main bearing surface profile was changed to include tolerances for Wt and Wc. The failure mode has not been observed since these changes were implemented. This work shows the wavelength spectral structure of the dimensional aspects generated by the honing process, and the dimensional wavelength spectral structure of the dimensional wavelenght dependence of the component performance. The indication is that for a form call-out to be effective i. Why are fits not used without keys or other holding devices? The reason is confidence and lack of knowledge of the application. If the variation in friction, temperature, measuring error, and surface finish is known, then the shrink fit becomes completely suitable for transmitting torque alone without the aid of notch causing key, set screws, and other expensive devices. An interactive technique for statistical tolerance analysis has been developed for a computer with graphic display. The computer program called TAP provides for random perturbation of parameter values, repeated evaluation of system performance, and display of distribution histograms. The interactive capability of the program enables the designer to introduce modifications to the system so that the relative effects of these changes can be quickly evaluated with the graphic display. Two applications are discussed to illustrate the adaptability of the technique to either linear or nonlinear problems. The digital simulation of an active circuit is used to show how the interaction with graphic display saves time in evaluating altenative designs. A hybrid dimulatin of an equalizer for a digital transmission system illustrates that complex time domain problems can be economically analyzed using TAP. In addition, it is shown how TAP is used to measure the reproducibility of an analog simulation. Tridimensional tolerance chains, Model, Dimensioning Abstract: The analysis of the difficulties encountered with traditional dimension chains in the description of the behaviour of a set of parts, with variation, has led us to develop a tridimensional model of variations. It is thus designed so as to treat the problem of transfer of dimensions. The definition of the model of the variation on surfaces of parts relies on a 2-type classification of defaults which allows to then connect them formally. With this model, the requirements of tolerancing have brought about a definition of two operators. The first determines the specification that may be found on a part by defining the intersection of the domains of deviation of surfaces in relation with their nominal model. The second one calculates the union of the set of motion of a part under the influence of the mating faces with contiguous parts. The implementation of the model and of the two operators then allows for a definition of the varied possible configurations of the mechanism. For each of these configurations, the constraints of tolerancing that are exerted on the geometry of each part in a mechanism can be expressed mathematically.

Statistically controlled experiments serve as a catalyst to design. These methods help engineers to build good quality into products, which should reduce the need to inspect bad quality out of them. This study is concerned with developing an improved methodology for producing high precision assemblies from low precision components. This new methodology is called "statistical selective assembly". A computer simulation model was constructed to investigate the strengths and weaknesses of the developed assembly concept, and numberous runs were used to ascertain the viability of the concept. The results were encouraging. Statistical sleective assembly proved to be an effective technique for reducing assembly variability. The use of the word "certification" raises the hair on the back of some peoples neck. Its use and misuse can bring numerous horror stories to mind. This discussion will review current needs in industry regarding effective use of tolerancing and how it impacts metrology. While this is necessarily a "new" topic, some technology advances have seriously undermined previous advances in real world aplications. Worldwide competition has obsoleted some previous methodology in order to maintain competitivemess. Many of these changes were long overdue, but some changes have created "holes" in the development cycle. The resultant program costs, litigation, and "assistance" from senior management could be phenomenal. As a result of these changes, we have had to take a fresh look at "What is it that must be accomplished? Basic design practices with a strong understanding of applying geometric controls are MUST to initiate a viable design. The use of sophisticated metrology equipment in an ideal invironment will NOT provide correct data unless it is used correctly. Identifying educational needs, expertise reuqirements and hands on applications experience are some of the methods being employed at Ford. Certification can play an important role in assisting us in this formidable task. If tolerances are interpreted as physical limits, then practices of grading, sorting and biasing violates assumptions of RSS tolerance analysis. Director, and Gary D. We describe a method by which a variety of statistical design problems can be solved by alinear program. We describe three key aspects of this approach. This work thus extends the applicability of a previously published algorithm, to the case of arbitrary pdf-norms and consequently to a wide variety of statistical design problems including the common mixed worst-case-yield maximization problem. Case Studies Brooks, K. Although the concept of statistical dimensioning was sugessted over thirty years ago, few assemblies actually required this approach in the early thirties. Today, the mass production of some types of critically dimensioned assemblies cannot be economically produced any other way. However, setting up a statistical dimensioning program is something more than the simple application of the laws of probability. It requires a closely co-ordinated program to make it function properly. Presented here is a guide to setting up such a program. This paper describes a feature-based tolerancing capability that complements a geometric solid model with an explicit representation of conventional and geometric tolerances. This capability is focused on supporting an intelligent inspection process definition system. For easy incorporation, the tolerance feature entities are interconncected with STEP solid model entities. This scheme will explicitly represent the tolerance specification for mechanical products, support advanced dimensional measurement applications, and assist in tolerance-related methods divergence issues. The basic idea is that automatic machine tools and measuring machines are perfectly repeatable just like the stars and the planets. They obey cause and effect relationships that are within our ability to understand and affordably control. There is nothing random or probabilistic about their behavior. Everything happens for a reason. The list of reasons is small enough to manage by common sense, good metrology, and a reasonable investment of resources. Some level of non-repeatability is observed in the performance of automatic machines. A determinist believes that all of this non-repeatability is caused by systematic sources and that there is no such thing as random behavior of an automatic machinel. We use the term "apparent non-repeatability" to emphasize this belief since each of the sources of apparent non-repeatability is itself repeatable if examined closely enough. The magnitude of apparent non-repeatability depends on the time, money, and skill of the user in creating the proper environment for the machine. Statistical measures of apparent non-repeatability have limited usefulness since they cannot be used to predict future machine performance if the time, money, and skill of the user changes. On line monitoring and control of the variables, such as temperature, are a better alternative. Statistical measures can be counterproductive in somehow implying that non-repeatability is the fault of the machine rather than the user. A determinist believes that any

automatic machine can be made to repeat to a value that is close to its resolution. The cost of doing so is not unreasonable when compared to the benefits. This paper provides simple process controls and acceptance sampling plans, which the design engineer can use, instead of the conventional specification limits for a part. These plans effectively control the distribution average and variability of the dimension. This can save great amounts of inspection, reworking, scrapping and can place the relations between engineering, production, and quality control on a more realistic basis. See also Burr, This paper urges placing the emphasis in tolerancing upon specifying controls upon the distributions of the various compoent part dimensions, so that the distribution of the assembly characteristic will meet requirements, that is, lie between specified limits. Gives RSS methods - defines tolerance as an indication of standard deviation and not a physical limit. Tolerance, Interchangeability, Manufacturing Cost Abstract: In discrete parts mass production, interchangeability is critical. All the component parts you manufacture need to consistently assemble to some minimum level of lift, functionality and finish. Manufacturing has developed a costly infrastructure to achieve this interchangeability. The problem is, this infrastrucutre performs at significantly below percent. And perhaps the bigger problem is that when the infrastrucutre fails, the consequences are expensive. The fact that we are spending so much to achieve so little is due to a factor in the equation that nobody has really recognized or addressed. This hidden factor is the implementation of tolerancing throughout design, manufacturing and inspection. A system, known as Valisys, automates tolerancing implementation, thus making it possible to insure part interchageability. The system performs design validation so that tolerance specifications properly reflect design intent.

Chapter 3 : ADCATS Research Bibliography A through F

Failure Prevention Associates is composed of certified experts in the field of condition monitoring and predictive maintenance. Our staff know how to help you understand the health of your machines. We have developed unique training classes, offering hands-on experience to help drive better understanding and competence when you get back to work.

The degree of protection they offer against HIV and STIs is significantly better than any other single prevention method, taken in isolation, other than sexual abstinence or complete mutual monogamy between two people who have tested negative for HIV. Despite this, the use and promotion of condoms continue to be targets for controversy and criticism, and sexual abstinence and monogamy are often promoted as superior alternatives. While condoms offer useful and vital protection, they have also become associated with promiscuity and infidelity. Museveni later complained of being misunderstood and signed an article in The Lancet saying that condoms formed a valuable part of HIV prevention. Therefore questions of condom efficacy have to be addressed and misapprehensions corrected. These margins of uncertainty Knowing how well they protect against other STIs is important for sexual health in general and may be particularly important for people with HIV, who may be more vulnerable to the effects of certain STIs. The main findings of studies we look at in more detail below are as follows: In other words, for every cases of HIV infection that would happen without condom use, about 15 range: Condoms offer a similar degree of protection against gonorrhoea. The best estimate we have is that using condoms more than three-quarters of the time halves the chance of acquiring HSV-2, and may reduce the chances of genital infection with the cold sore virus HSV-1 too. Another has found that condom use helps to prevent HPV infection progressing to cervical or penile cancer in both women and men. These are based upon observations of their use in contraception: Condoms are, however, the only method on that list that has been shown to protect against STIs as well as pregnancy. Laboratory studies and product testing have shown that reputable condoms tested in the laboratory are completely impermeable to micro-organisms as small as viruses. In these circumstances, it is easy to see why condoms sometimes fail, even in consistent users. In addition, however, people are not consistent in their use of condoms, and may not even be consistent when they claim to be, or think they are. Women were much less likely to report inconsistent use of condoms than never using them: The efficacy of an intervention is how well it works in a scientific trial or when people use it as indicated, i. Because these studies involve private behaviours that investigators cannot observe directly, it is difficult to determine accurately whether an individual is a condom user and whether condoms are used consistently and correctly. The next problem is deciding what kind of study provides truly reliable evidence. It would be unethical to mount a randomised trial of condom use because the control group would have to stop using them altogether. The evidence we have is based on three types of trials, and each has potential weaknesses. These can be done in individuals whose characteristics are known and can be controlled for, and if the relationship truly is monogamous then infections by acute STIs and from outsiders can be ruled out. One disadvantage is that condom use in long-term relationships, even in serodiscordant couples, is relatively rare. Another is that the HIV-positive partner will be chronically infected and so will not have the very high viral load characteristic of acute HIV infection. For these reasons, HIV transmission within long-term serodiscordant relationships, especially heterosexual ones, may be rarer than it is between casual sex partners. Another kind of study is to conduct a prospective cohort study, looking at differences in HIV incidence between two groups of people according to their usage of condoms. There is opportunity for qualitative research too, contrasting attitudes and drivers of behaviour between people who become infected with HIV or other STIs and those who do not. Condom efficacy against acute STIs can also be measured, if people have multiple partners, or their partners do. The weaknesses of this kind of study include the fact that condom use cannot be corroborated by partners, so self-report is likely to be even more unreliable. A study that measures HIV incidence in condom users and non-users will be confounded, for instance, if one group has substantially fewer sexual partners than the other. For this reason and because HIV seroconversion even in high-risk populations is a relatively uncommon event,

prospective cohort studies have to be large and can be quite costly. A third kind of study is to conduct a retrospective cohort study, asking people about their condom use and contrasting HIV and STI prevalence in users and non-users. Retrospective cohort studies are subject to greater limitations that prospective ones. For all these reasons, measuring the efficacy of condoms or indeed other established prevention methods and strategies such as serosorting can be challenging. Nonetheless, a number of carefully conducted studies have demonstrated that consistent condom use is a highly effective means of preventing HIV transmission. When it comes to STIs other than HIV, most epidemiologic studies of these are characterised by methodological limitations, and thus, the results across them vary widely - ranging from demonstrating no protection to demonstrating substantial protection. However, we now have enough evidence to demonstrate that condoms offer at least some and in some cases excellent protection against most STIs. Review by NIAID Given that condoms have been promoted as the first line of defence against HIV since the beginning of the epidemic, at least in the developed world, it is perhaps surprising that a really rigorous review establishing their efficacy against HIV and STIs was not conducted till June , 11 when the US National Institute of Allergy and Infectious Diseases NIAID conducted a review of the evidence for their efficacy, spurred on partly by a political climate in the US which at the time was turning against the promotion of condoms and contraception, and towards abstinence and monogamy as the favoured method of protecting against STIs and pregnancy. It also prefaced this with the following warning, in bold print: For persons whose sexual behaviors place them at risk for STDs, correct and consistent use of the male latex condom can reduce the risk of STD transmission. However, no protective method is percent effective, and condom use cannot guarantee absolute protection against any STD. The NIAID review first determined the risks of exposure to semen due to condom breakage and found that this, given that breakage is quite rare, was a low risk: It also reviewed patterns of condom use amongst people in the US. The sample only included serodiscordant, sexually active, heterosexual couples HIV status was determined by serology so that exposure to HIV was known Data collection included self report about condom use The study design afforded longitudinal follow-up of HIV uninfected partner. Davis and Weller found 12 studies that met these criteria. The meta-analysis noted the direction of transmission male-to-female, female-to-male, and unstated and date of study enrolment. Condom usage was classified into the following three categories: To cite one of the 12 studies in more detail, 18 researchers looked at Italian serodiscordant couples in which the male partner was HIV positive. Annual HIV incidence was 7. Davis and Weller subsequently published another meta-analysis in , 19 this time of 14 studies. The studies with the longest follow-up time, consisting mainly of studies of partners of haemophiliac and transfusion patients, yielded an HIV incidence estimate of 5. In these nine studies there were only four seroconversions reported among 1. In contrast, when condoms were used inconsistently or not at all, of This is about the highest standard of proof we can expect from studies of condom efficacy. Taking Davis and Weller and Pinkerton together, one can say that the best efficacy estimates we have for the use of condoms in preventing HIV are: The paradox of intermittent use One fact that at first sight seems puzzling is that a number of studies of condom efficacy report that inconsistent use of condoms is in some cases worse than not using them at all. To take one study from Rakai, Uganda: He found that annual HIV incidence in non-users was 1. But he found that HIV incidence in inconsistent users was 2. Consistent condom users had half as many cases of gonorrhoea or chlamydia as non-users â€" again, broadly in line with other studies. How can sometimes using condoms be worse than never using them? The confounder which distorts these figures is sexual risk behaviour. The same paradox applies in studies of anal sex â€" see the next section. Or rather, in anal sex, as this is the transmission behaviour in question? But there has been only one small analysis of the extent to which using condoms actually prevents HIV infection in people who have anal sex, compared with people who do not use condoms. This may be because the figures for vaginal sex are simply extrapolated to anal sex; it may also be because, in gay men at least, a lot of HIV transmission happens in casual situations where the HIV serostatus of partners cannot be assessed, and so the degree of HIV exposure risk are difficult to quantify. A small review of condom efficacy and anal sex 22 found two studies amongst gay men and one amongst women that gave some indication of the relative effectiveness of condom use in anal sex. The one in women followed seroconversions amongst serodiscordant heterosexual couples and did ask whether they had anal intercourse. Anal intercourse

was already a minority behaviour and unprotected anal intercourse even rarer, and the researchers could not directly compare seroconversion rates between women who used condoms for anal sex and ones who did not. The only large longitudinal study of condom efficacy in gay men was published back in Again, this is probably because men who never used condoms were likely to include monogamous men and ones who had less anal sex. The only later data we have relating HIV incidence among gay men to condom use come from retrospective studies of gay men diagnosed with HIV who were asked about their condom use. The rate of new HIV diagnosis among men who attempted always to use condoms was 1. This is a retrospective epidemiological study with nothing like the same degree of rigour as the studies of HIV serodiscordant couples, but, like the MACS study, it does yield an estimate of condom efficacy somewhat but not hugely lower than the lower bounds of condom efficacy noted in the Weller and Davis and Pinkerton meta-reviews. Does anal sex need stronger condoms? Is one of the reasons condoms appear somewhat less protective during anal sex that they are more likely to break? There have been plenty of studies of condom failure breakages, slipping off, etc. For instance, a Dutch study 26 of gay men, one-third of them HIV-positive, found that the overall failure rate during male-to-male anal sex was 3. The failure rate with the use of water-based lubricants was 1. Each couple was provided with nine condoms and completed a questionnaire after each sexual act. The researchers found that condoms broke for the same reasons as previously identified in studies among heterosexual couples: Use of additional inappropriate lubricant oil-based or saliva was also associated with condom breakage. Penis length was also associated with condom breakage, yet girth was not. The study found no significant differences between the two types of condoms with respect to breakage or slippage. Condoms were more likely to slip if lubricant was placed on the penis under the condom. A low incidence of breakage was reported for both condom types during appropriate use. Here, it found four studies that reported reductions in gonorrhoea associated with condom use, though only one study measured consistent and correct condom use. This may well have therefore underestimated the degree of protection offered by condoms. The only prospective study was one from in which the incidence of gonorrhoea in sailors who were clients of the same group of sex workers was studied. As this was in pre-AIDS days, condom use was low and only 29 out of sailors consistently used condoms 5. Nonetheless, it found no gonorrhoea infections in the 29 sailors who used condoms compared with 51 Syphilis The only other STI for which some degree of evidence on condom efficacy existed was syphilis, although this was hampered by the fact that at the time of the NIAID review, 11 syphilis prevalence in the population was at an historically low point. Another, amongst men attending STI clinics, found 2. However, in , the World Health Organization WHO , benefiting from new study evidence, issued its own review 29 in which it was able at least to hazard a guess at condom efficacy against all STIs except human papillomavirus HPV , the genital wart virus. Chlamydia One prospective study in Peru 30 provided female sex workers with free condoms and safer sex advice and asked them to return for monthly examinations, STI treatment if necessary and evaluation of condom use over a period of 15 months. There was also a significant, though not quantified, reduction in the risk of trichonomiasis. All the other studies cited by WHO studied the combined risk of gonorrhoea, chlamydia and syphilis or trichonomiasis.

Chapter 4 : ARTECH HOUSE USA : Systems Reliability and Failure Prevention

Get this from a library! Failure prevention and reliability, presented at the ASME design technology conferences, 7th Biennial Conference on Failure Prevention and Reliability, Boston, Massachusetts, September ,

Parkinson , " Tolerance analysis is receiving renewed emphasis as industry recognizes that tolerance management is a key element in their programs for improving quality, reducing overall costs and retaining market share. The specification of tolerances is being elevated from a menial task to a legitimate engineer The specification of tolerances is being elevated from a menial task to a legitimate engineering design function. New engineering models and sophisticated analysis tools are being developed to assist design engineers in specifying tolerances on the basis of performance requirements and manufacturing considerations. This paper presents an overview of tolerance analysis applications to design with emphasis on recent research that is advancing the state of the art. Major topics covered are: Chase, Jinsong Gao, Spencer P. Magleby - Journal of Design and Manufacturing , " Assembly tolerance analysis is a key element in industry for improving product quality and reducing overall cost. It provides a quantitative design tool for predicting the effects of manufacturing variation on performance and cost. It promotes concurrent engineering by bringing engineering requireme It promotes concurrent engineering by bringing engineering requirements and manufacturing requirements together in a common model. A new method, called the Direct Linearization Method DLM , is presented for tolerance analysis of 2-D mechanical assemblies which generalizes vector loop-based models to include small kinematic adjustments. It has a significant advantage over traditional tolerance analysis methods in that it does not require an explicit function to describe the relationship between the resultant assembly dimension s and manufactured component dimensions. Such an explicit assembly function may be difficult or impossible to obtain for complex 2-D assemblies. The DLM method is a convenient design tool. The models are constructed of common engineer Show Context Citation Context An explicit assembly function is required to permit substitution of random sets of component dimensions and compute the change in assembly variables for each assembly. Variation Sources in Assem Magleby, Jinsong Gao , " A new method, called the Direct Linearization Method DLM , is presented for tolerance analysis of 2-D and 3-D mechanical assemblies, which generalizes vector loop-based models to include small kinematic adjustments. Such an explicit assembly function may be difficult or impossible to obtain for complex assemblies. The models are constructed of common e Assembly Kinematics The ki Manufacturing by Karl E. Sheldon , " Few aircraft engine manufacturers are able to consistently achieve high levels of performance reliability in newly manufactured engines. Much of the variation in performance reliability is due to the combined effect of tolerances of key engine components, including tip clearances of rotating compone Much of the variation in performance reliability is due to the combined effect of tolerances of key engine components, including tip clearances of rotating components and flow areas in turbine nozzles. This research presents system analysis methods for determining the maximum possible tolerances of these key components that will allow a turbine engine to pass a number of specified performance constraints at a selected level of reliability. Through the combined use of a state-of-the-art engine performance code, component clearance loss models, and stochastic simulations, regions of feasible design space can be explored that allow for a pre-determined level of engine reliability. As expected, constraints such as spool speed and fuel consumption that are highly sensitive to certain component tolerances can significantly limit the feasible design space of the component in question. Discussed are methods for determining the bounds of any components feasible design space and for selecting the most economical combinations of component tolerances.

Chapter 5 : HIV & AIDS Information :: Condoms and lubricants - Do condoms work?

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Abstract. There is an evident lack of information about military-type relays regarding their reliability, failure mechanisms and modes. In trying to fill this gap, even partially, this paper deals with different findings of internal visual inspection (IVI), failure analysis (FA) and a proposal for screening tests of relays as have been carried out in our laboratory.

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Failure Prevention Associates, LLC. (FPA) is comprised of staff certified in Vibration Analysis, Thermographics, Ultrasound Inspection, Electric Motor Testing, Field Balancing, Laser Alignment, and Reliability Centered Maintenance Practice.